The Service Generation Apparatus for IPTV Interactive Digital Channel

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Abstract

In this paper, a service generation apparatus is proposed for easily setting up an IPTV interactive digital channel by a channel service producer incapable of programming. The apparatus convergences different characteristics of set-top boxes, display screens, multimedia data and generates the service channel automatically. A design example and demonstration illustrates the schematic architecture of the apparatus. It is currently used in CHT MOD service to meet the increasing capacity of IPTV consuming market.

Keywords: IPTV, set-top box, XML, SMIL, MPEG-21

1. Introduction

Nowadays, based on the needs of audio-video entertainments by customers and advanced network development, the IPTV has been intensely developed by the telecommunication, multi-media, and network research staffs. The IPTV takes advantage of existing switched telephone networks to provide users a variety of services such as telephoning, television watching, movie enjoying, Kala OK entertaining, and high-speed networking, which can be optionally picked by users at any time [1],[2]. In Taiwan, the IPTV service is provided by Chunghwa Telecom (CHT) Co. known as CHT MOD (multimedia on demand) service since 2004. It is with ATM as backbone network, ADSL as client side's access network and a set-top box at user client that decodes MPEG-2 video and displays video on NTSC TV screen [10], [11].

However, there are lots of different types of IPTV set-top boxes, which mean that package types of the browser software and the control codes of the remote controllers used by different types of set-top boxes are mostly different. Consequently, while setting up a digital channel for certain set-top box or remote controller, design engineers are required to make corresponding reprogramming for constructing the architecture of the digital channel so that the digital channel can be enjoyed by customers. Therefore, the traditional method for setting up digital channels is almost impossible to be employed by a channel service producer who is familiar with how to design the architecture of the digital channel without knowing how to program. Accordingly, the abovementioned traditional method for setting up digital channels can not meet the increasing capacity of IPTV consuming market due to the increasing digital services.

For that reason, there is a big need for providing a digital channel generation apparatus for easily setting up a digital channel by a channel service producer incapable of programming to solve the aforementioned problems.

In accordance with the objective, a digital channel generation apparatus for setting up a digital channel by a channel service producer is provided. The digital channel generation apparatus comprises a storage unit, a service generation interface, and a processing unit. The storage unit is utilized for storing a plurality of set-top box data, a plurality of electronic device data, a plurality of multimedia data, and at least one channel set-up template. The service generation interface coupled to the storage unit provides the channel service producer a functionality of selecting at least one electronic device data from the plurality of electronic device data. Furthermore, the service generation interface provides the channel service producer a functionality of inputting a set-up data of the digital channel based on the channel set-up template. The processing unit coupled to the service generation interface generates the digital channel for broadcasting the plurality of multimedia data based on the selected electronic device data, the plurality of set-top box data, the channel set-up template and the set-up data.

This paper is organized as the followings. The related work is described in section 2. Then, the proposed apparatus architecture is introduced in section 3. Detailed description of the preferred embodiment is illustrated in a design example and demonstration in section 4. Finally, we conclude the work and its applying to CHT MOD service in section 5.

2. Relate work

For the rapid progress of digital convergence technologies, the web's reach is beyond the desktop to the devices such as mobile phones and TV with set-top boxes [15]. Many researchers propose reusable architectures to adapt the web based services or applications to meets various client device capabilities [3],[5],[6],[8],[12]-[15]. These client devices for example IPTV, PC and mobile devices feature different screen size, interactive input control and access bandwidth in nature [4],[9],[14],[15]. Therefore, the presentation, interaction and performance are three major concerns for these reusable architectures.

Venkatakrishnan Balasubramanian Appiah and San Murugesan conclude various techniques for presentation of web pages on hand-held devices [8]. These techniques are page block, zonezoom, fisheye, thumbnail, directory and structure-aware directory. But the interactive input device capability and access bandwidth issues are not discussed. Nico Oorts etc. have worked on the adaptation issue for a long time and proposed a XiMPF（eXtensible Interactive Multimedia Publication Format）data model which bases on MPEG-21 Digital Item Declaration Language (DIDL) and XML to adapt the web service to different multimedia consumption devices [5],[12]-[14]. The adaptation not only includes the presentation layout issue, but also the interactivity and synchronization of multimedia resources. The presentation-oriented requirements are concluded as spatial model, temporal, interactivity, real-time composition and adaptation in [14]. The interactivity issue is introduced in [5]. The authors present a publication infrastructure which generates content for multiple client devices. The publication system is applied to the news site of the leading Belgian broadcaster VRT, generating adapted content for four platforms: PC, TV with set-top box, PDA and SMIL based players [5].

The XiMPF provides a good solution for the adaptation problem. It provides the hierarchy model to describe the web page presentation layout and that is independent with its implementation [5]. This approach well reuses the multimedia resources by describing the web page layout semantically but not concerns the performance issue due to the client

device's capability. In system practice, the web page performance issue and input device interactivity issue are needed more considerations.

Take the IPTV system with the set-top box for example. For the cost down concern, the set-top box's performance is not as same as the desktop. Besides the system resource limitation, IPTV user's viewing behavior issue also makes the web page design different from the desktop. For the desktop users, the input or navigation devices are keyboard and mouse. When they click one button or keystroke, they usually watch the response from the computer. But for IPTV users, they use remote controllers as their interactive devices and they are used to the quick response of traditional TV services. In web-based IPTV services, the browsing and navigation procedure are similar to Internet web-based services. The system loads the web pages from web servers and the browser in the set-top-box then processes web pages and displays the results on TV screen. Due to the limited processing power of set-top-box, the response time of web page transition is not as quick as expectation of traditional TV services. Most IPTV users do not know these procedures, they just wonder if something wrong in the system. Then a lot of remote controller presses are issued and finally the set-top-box crashes. Turn-off the set-top-box and turn-on again seems the only way that users can do for the situations. In our previous work [7], two practical solutions is adopted in our system design. *Key-lock* mechanism is used to disable all the inputs during the web page transition that avoids system crash. *Scrolling* mechanism is used to reduce the number of web transition of an IPTV service. The web page transition usually occurs when a page is leaving and a new page is loading.

```
function Termnate(){
LockKey();}

document.onunload=
```
web page A

web page A is leaving and
web page B is loading

```
document.onkeypress =
    function(){ return false };

function init() {
  document.onkeypress =
    function(){ return
    key_handler(event) };
};

document.onload =
    function(){ init();};
```
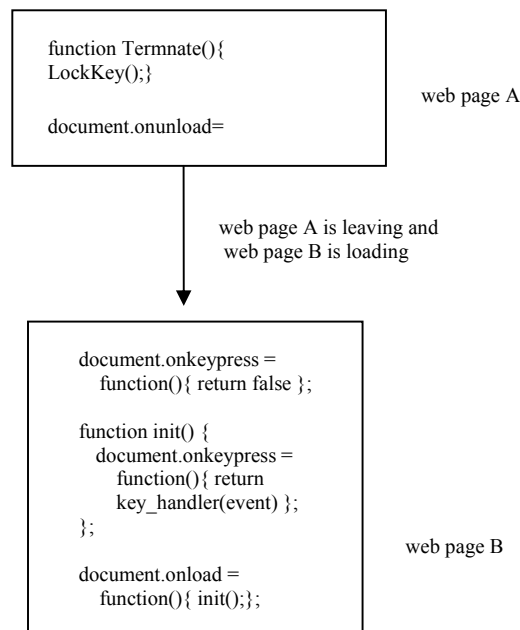web page B

Figure 1. The *key-lock* mechanism during web page transition

During the transition, the system design is to disable all the inputs from users and make sure the transition is safe. To assure the *key-lock* during the transition, *key-lock* mechanism is activated when current page is leaving and the new page is fully loaded. Figure1 shows the *key-lock* mechanism for the web page transition. Due to the slow transition of web pages, avoiding lots of web page transition in a service is a key design concept. In traditional web applications, the browser can resize its display window, and if the page presentation exceeds

the size, then a scroll bar in horizontal axis or vertical axis will appear such that the user can scroll the presented page. But for IPTV services, TV screen resolution is fixed (e.g. NTSC screen is set to 720X480) and it lacks the input devices (e.g. mouse) for a user scrolls the presented page manually so that the exceeded part of the presented page can not be seen on screen by user. This feature gives a good direction for the web page design to avoid lots of web page transition. Figure2 assumes three menu items and an area on the right side to show the corresponding information page when a menu item is selected. According our design described above, the information pages for Menu-item-1, Menu-item-2, and Menu-item-3 are all loaded in one web page transition. If a user selects Menu-item-2, our web page program just scrolls to the corresponding position of the information page of Menu-item-2. For the TV resolution is fixed, only Menu-item-2 information page can be seen on the screen and information pages of Menu-item-1 and Menu-item-3 are hidden on the screen(even though they are loaded). Therefore, the proposed generation apparatus in this paper, only a certain web page templates are considered for the production system and these templates are performance-oriented in accordance with specific client devices.
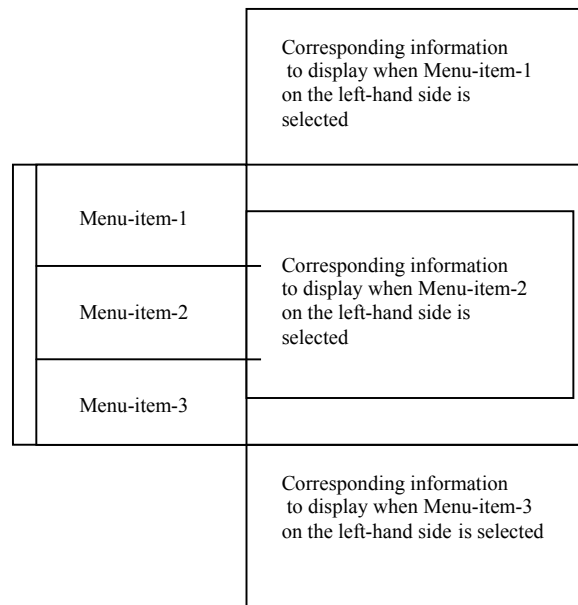

Figure 2. An example for the menu application using scrolling design

As for the interactivity issue [5], an API set is defined as the generic interface of the interactive behavior. Then, an interaction description in the XiMPF document links the parameters and features from the API with specific XiMPF items. Finally, the API is implemented for a certain platform. When the web page interactivity event element is triggered, the corresponding action will activate. But in system practice, detection of which input device is important and different input devices feature different interactivity event elements even for the same platform (e.g. HTML, JavaScript, VBScript or Java). For example, Table I shows the activated methods for "confirm" button of the remote controller for the three different set-top boxes (IP420, MOD201, MOD202) used in used in CHT MOD [7], [10], [11]. For set-top boxes IP420 and MOD201, the event methods for the "confirm" button are "onkeypress", but the "onkeydown" for MOD202, even though these set-top boxes are with the same HTML platform.

Table 1. The event methods for the "confirm" button of
remote controller for different set-top boxes

	IP420	MOD201	MOD202
onkeydown			V
onkeypress	V	V	

Table 2 shows the different key code definitions for the same direction buttons of the remote controller for these set-top boxes. Therefore, the characteristics of set-top boxes or input devices must be parameters for the web page generation.

Table 2. The key codes for the direction buttons of the
remote controller for different set-top boxes

	IP420	MOD201	MOD202
Back space	1073741953	1342177296	80
→	1073741841	1073741841	39
←	1073741840	1073741840	37
↑	1073741838	1073741838	38
↓	1073741839	1073741839	40

Although XiMPF provides a production system to generate a service for a target platform [5], it is almost impossible to be employed by a channel service producer who is familiar with how to design the architecture of the digital channel without knowing how to program on XiMPF model. For that reason, there is a big need for providing a digital channel generation apparatus for easily setting up a digital channel by a channel service producer incapable of programming to solve the aforementioned problems.

3. The proposed generation apparatus

Base on the above discussions, a generation apparatus is proposed easily and automatically generating an interactive channel service which considers the input device capability, performance-oriented presentation templates, and client device capabilities. The above and other objects and features of the proposed generation apparatus will become apparent from the subsequent description of preferred embodiments given in conjunction with the following accompanying drawings.

Figure 3 is a schematic block diagram showing the apparatus. The apparatus comprises a storage unit 31, a service generation interface 32, and a processing unit 33. The storage unit 31 stores a plurality of set-top box data 34, a plurality of electronic device data 35, a plurality of multimedia data 37, and at least one channel set-up template 36. The set-top box data 34 comprises the model number of the set-top box, the information of the browser (ex: IE or NESCAPE) used by the set-top box, and the information of the remote controller used by the set-top box. The electronic device data 35 is a television data, a computer data, or a mobile

phone data. The electronic device data comprises the information of display resolution of the corresponding electronic device. The channel set-up template comprises a main channel page, a sub-channel page, a marquee text or a film introduction page. The multimedia data comprises a multimedia file, a web site data, a multicast data or a picture file.

The service generation interface 32 provides channel service producers a functionality of selecting one electronic device data 351 corresponding to an electronic device used by channel service producers from the plurality of electronic device data 35. Furthermore, the service generation interface 32 provides channel service producers a functionality of inputting the set-up data 38 of a digital channel based on the channel set-up template 36. The processing unit 33 adjusts the page layout of the digital channel based on the information of display resolution of the selected electronic device data and generates an interactive digital channel service for broadcasting the multimedia data 37 based on the selected electronic device data 351, the set-top box data 34, the channel set-up template 36 and the set-up data 38.

While making use of a channel service generated by the apparatus, the service is capable of detecting device model of the set-top box used by the users, and selects one of the plurality of set-top box data 34 complied with the set-top box used by based on the device model of the set-top box. Alternatively, the service generation interface 32 may provide channel service producers a functionality of selecting one of the plurality of build-in set-top box data 34 manually, channel service producers and the processing unit 33 is able to generate a channel service for broadcasting the multimedia data 37 based on the selected electronic device data 351, the selected set-top box data, the channel set-up template 36 and the set-up data 38.

Figure 4 is a schematic block diagram showing a preferred embodiment of the apparatus. The set-top box 44 stored in the storage unit 41 comprises six sets of set-top box data used by CHT MOD [7],[10],[11], which are DSL4000 data 441, IP420 data 442, MOD201 data 443, MOD202 data 444, MOD203 data 445, and MSD508 data 446. Each set-top box data comprises the information of package type of a build-in browser and a look-up table recording the control codes in conjunction with corresponding functionalities of a remote controller. Because the message code definition concerning different package type of browser is different, the page control mode of the digital channel is also different. Consequently, the apparatus stores information of various package types of the build-in browsers used by various set-top boxes so that the channel service under processing is able to detect device model of the set-top box currently being used so as to make use of the set-top box data 44. Alternatively, channel service producers may select one device model of the set-top box manually while setting up the channel service.

The electronic device data 45 comprises three different types of electronic device data concerning highly commercialized electronic devices for receiving digital information, which are the television data 451, the computer data 452, and the mobile phone data 453. Each electronic device data comprises the information of screen resolution of the corresponding display. The multimedia data 47 stored in the storage unit 41 comprises the multimedia files 471, the web-site data 472, the multicast data 473, and the picture files 474.

The service generation interface 42 provides channel service producers a functionality of selecting one electronic device data 459 corresponding to an electronic device used by the users from the plurality of electronic device data 45. Furthermore, the service generation interface 42 provides channel service producers a functionality of inputting the set-up text 481 of a digital channel based on the channel set-up template 46. Moreover, the service

generation interface 42 provides channel service producers a functionality of selecting the set-up picture 482 from the picture files 474 stored in the storage unit 41. All the above-mentioned functionalities are illustrated in the following design example and demonstration.

4. The design example and demonstration

Figure 5 shows a schematic exemplary structure of the channel set-up template in accordance with the apparatus. The channel set-up template comprises a main channel page 51, a sub-channel page 521, a sub-channel page 522, a sub-channel page 523, a marquee text 53, a film introduction page 541, a film introduction page 542, and a film introduction page 543. The main channel page 51 is linked to at least one sub-channel page. The page types of the sub-channel pages can be categorized into at least an information bulletin board page, a film content page, and an electronic photo album page. Each sub-channel page is selectively linked to at least one page according to the feature of the sub-channel page.
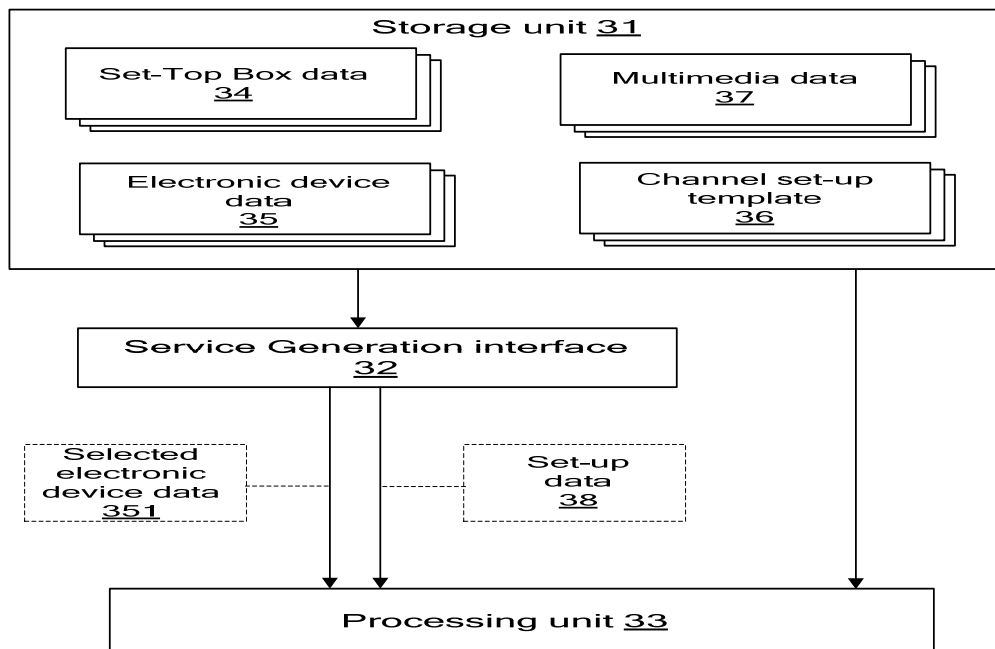
Figure 3. The schematic block diagram of the proposed generation apparatus

For instance, the sub-channel page 521 can be set to be an information bulletin board page, the sub-channel page 522 can be set to be a film content page, and the sub-channel page 523 can be set to be an electronic photo album page. The sub-channel page 522 can be further linked to the film introduction page 541, the film introduction page 542, and the film introduction page 543. The marquee text 53 can be linked to and displayed on the main channel page 51.

Figure 6A to 6D demonstrate an exemplary interactive digital channel service of a library based on the corresponding exemplary structure of the channel set-up template shown in Figure 5. The main channel page 51 displays the main content of the digital channel as shown in Figure 6A. The digital channel of the library includes three digital subjects as "About The

Library", "Film Entertainment", and "The Library Ages Ago", which are provided for users to select desired subject. The marquee text 53 comprising text of "Welcome your coming" is displayed on the main channel page 51 animatedly. When users click the option of "About The Library", the sub-channel 521 shown in Figure 6B is linked and displayed. When users click the option of "Film Entertainment", the sub-channel 522 shown in Figure 6C is linked and displayed. The sub-channel page 523 shows an electronic photo album concerning the option of "The Library Ages Ago".
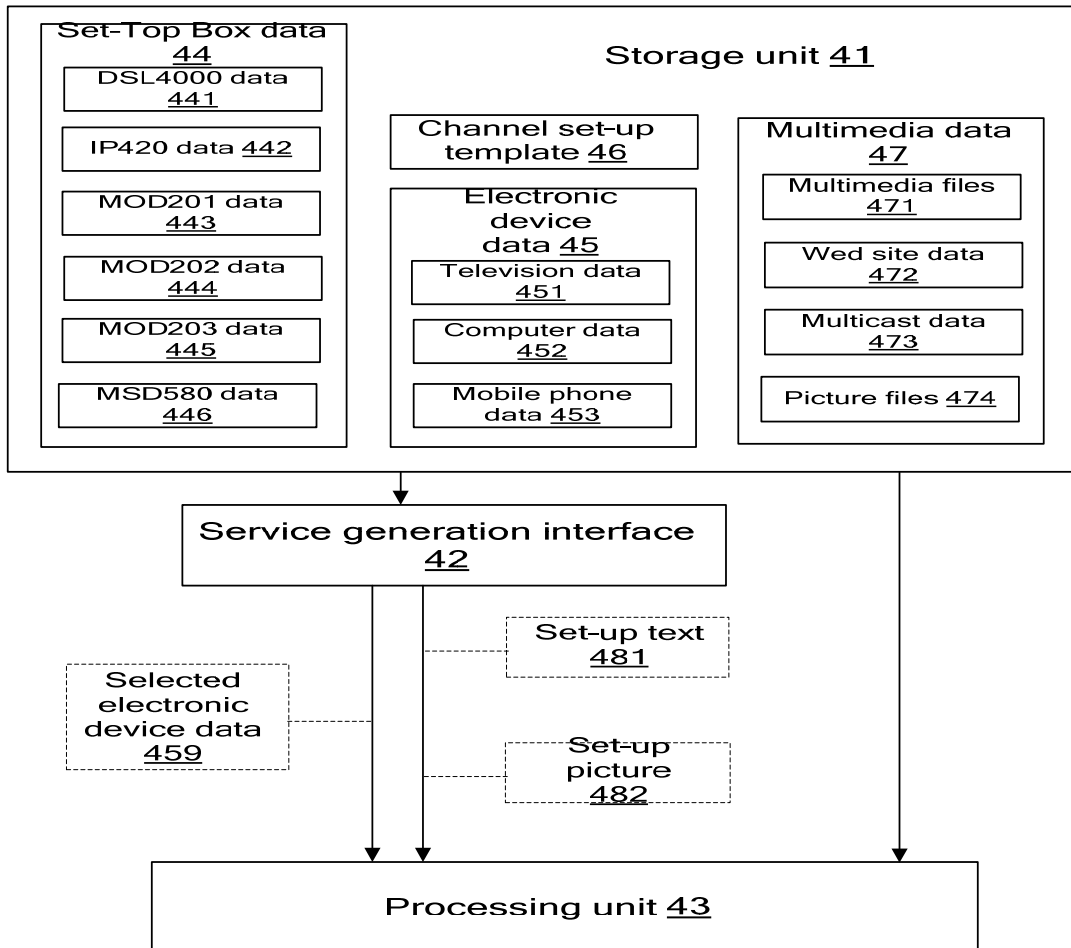
Figure 4. The block diagram of the preferred embodiment of the apparatus

Figure 6B shows the information bulletin board page concerning the option of "About The Library". The information bulletin board page 521 includes a description text, a library picture, an information title, a "SCROLL" option and a "BACK" option. When users click the "SCROLL" option, the information bulletin board page will switch to another set of the description text, the library picture, and the information title.

Figure 6C shows the film content page concerning the option of "Film Entertainment". The film content page 522 displays options of "Sun Tzu Military Strategy", "Around The World In 80 Days" and "The Day After Tomorrow", and a picture concerning the option of "Sun Tzu Military Strategy" selected by the option cursor. When users click an option, a

corresponding film introduction page is linked and displayed. Figure 6D shows a film introduction page concerning the option of "Sun Tzu Military Strategy". The film introduction page 541 displays a film picture, a film depiction, a film title, a film length, a "PLAY" option and a "BACK" option. When users click the "PLAY" option, the film of "Sun Tzu Military Strategy" is played. When users click the option of "Sun Tzu Military Strategy" in Figure 6C, the introduction page 541 shown in Figure 6D is linked and displayed. When users click the option of "Around The World In 80 Days" in Figure 6C, the introduction page 542 is linked and displayed. When users click the option of "The Day After Tomorrow" in Figure 6C, the introduction page 543 is linked and displayed.

Figure 7 shows a schematic diagram of the service generation interface of a preferred embodiment of the apparatus. The service generation interface is utilized to set up a film introduction page. The service generation interface provides a plurality of columns for channel service producers to enter option title, start time, end time, film title, film length, and film depiction. Furthermore, the service generation interface provides browse functions so that channel service producers can select option picture file and film picture file to be displayed and select multimedia data to be broadcasted through browsing options. The filled text and the selected picture file are displayed in the pages of Figure 6C and Figure 6D. The start time and the end time mean that the selected film is available for entertainment only in the time duration between the start time and the end time. When channel service producers select the multimedia files 471 as the multimedia data, the digital channel broadcasts audio-video content based on a file play mode. When channel service producers select the web site data 472 as the multimedia data, the digital channel links the web site and broadcasts audio-video content based on a real-time streaming play mode. When channel service producers select the multicast data 473 as the multimedia data, the digital channel links the multicast web site and broadcasts audio-video content based on a multicast streaming play mode.

Based on the above description, channel service producers can set up an interactive digital channel service through the service generation interface 42 based on the channel set-up template 46 by inputting the set-up text 481 and selecting the set-up picture 482 from the picture files 474 stored in the storage unit 41. That is to say, any channel service producer without knowing how to program is able to set up a channel service. Therefore, the processing unit 43 is able to generate the interactive digital channel service for broadcasting multimedia data 47 based on the selected electronic device data 459, the set-top box data 44, the channel set-up template 46, the set-up text 481 and the selected set-up picture 482. Furthermore, the processing unit 43 is able to adjust the page layout of the channel service according to the display resolution of the selected electronic device data 459.

Figure 8 is a schematic diagram showing an exemplary channel page of a mobile phone generated by the apparatus. Because the mobile phone data 453 is selected as the desired electronic device data, the processing unit 43 adjusts the page layout of the digital channel based on the screen resolution of the mobile phone recorded in the mobile phone data 453. Compared with the page screen shown in Figure 6D being used for a television display, the processing unit 43 shrinks the displayed picture to comply with the lower screen resolution of the mobile phone. Furthermore, because the aspect ratio of the screen of the mobile phone is higher than that of the television, the processing unit 43 makes a longitudinal layout for the film picture, the film briefing, the film title, the film length, the "PLAY" option and the "BACK" option so that the displayed screen is clearer for users.
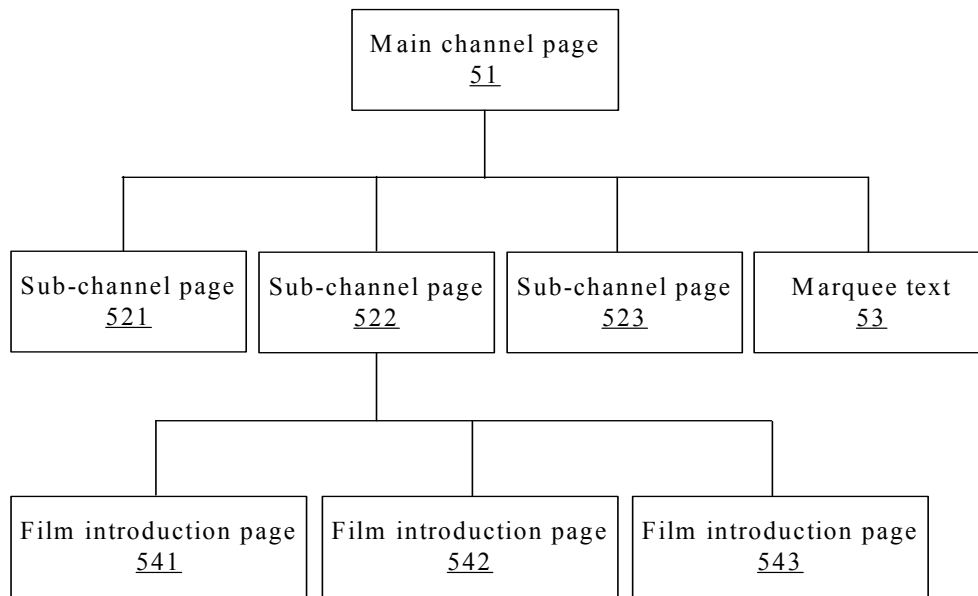
Figure 5. The schematic exemplary structure of the channel set-up template in accordance with the proposed generation apparatus
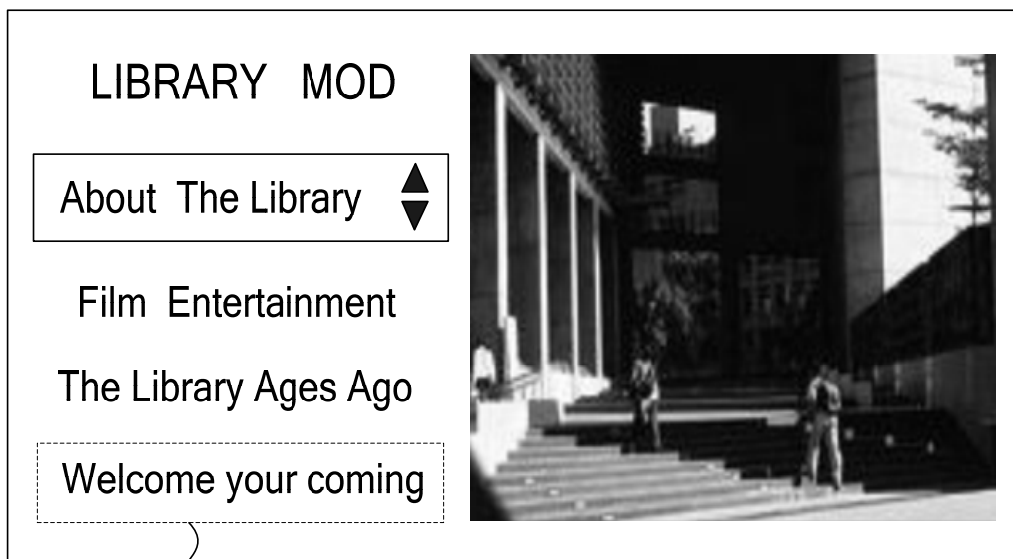

Figure 6A. An example of a main channel page

521

Information Bulletin Board
About The
Library

The Library was built in 1959 and has a current collection of over two hundred thousand volumes and about ten thousand electronic periodicals. The Library aims to provide public service, conservation of local literature and promotion of academic research through services including information collection, reading access, references, promoting training and disabled services.

△▽ SCROLL ◯ BACK

Figure 6B. An example of an information bulletin board page

522

Film Entertainment

| Sun Tzu Military Strategy | ▲ ▼ |

Around The World In 80 Days
The Day After Tomorrow

Figure 6C. An example of a film content page

Figure 6D. An example of a film introduction

Figure 7. The schematic diagram of the service generation
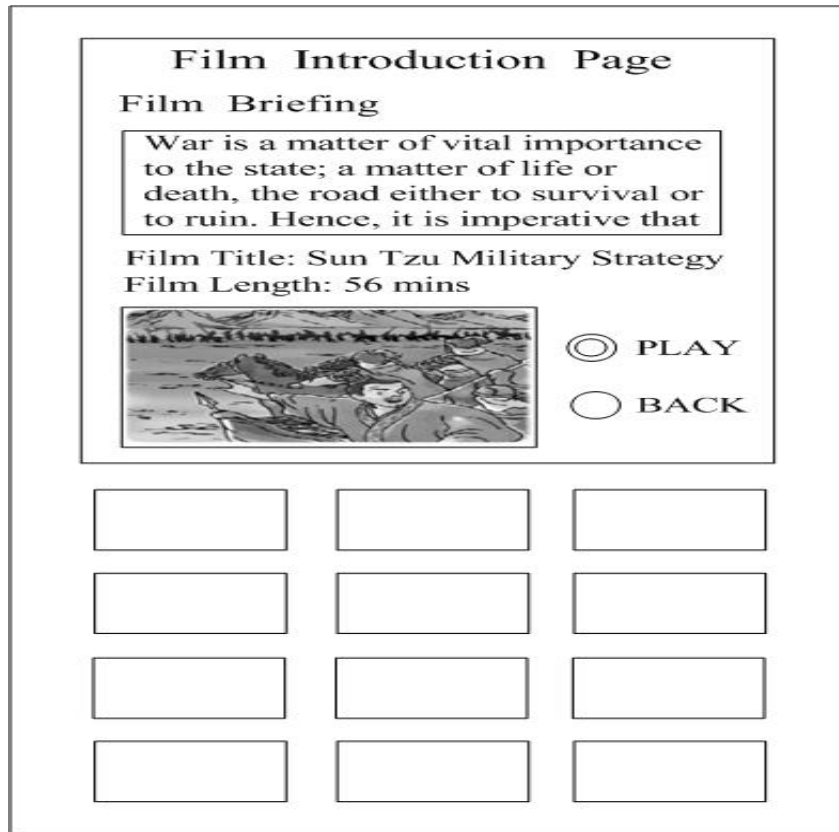interface of a preferred embodiment of the apparatus

Figure 8. The schematic diagram of an exemplary channel page
of a mobile phone generated by the apparatus

5. Conclusions

This paper presents a digital channel generation apparatus for setting up an interactive IPTV digital channel by a channel service producer, comprising a storage unit, a service generation interface and a processing unit. It convergences different characteristics of set-top boxes, display screens, multimedia data and generates the service channel automatically. This apparatus has been used in CHT MOD service. It provides a quick and performance-oriented interactive digital channel service production to meet the increasing capacity of IPTV consuming market.

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References

[1] Ortiz, S., Jr. "Phone Companies Get into the TV Business", IEEE Computer, Volume 39, Issue 10, pp.12-15, Oct. 2006.

[2] Vedantham, S., Seong-Hwan Kim, Kataria, D.," Carrier-grade ethernet challenges for IPTV deployment", IEEE Communications Magazine, Volume 44, Issue 7, pp. 24-31, July 2006.

[3] Pemberton, L .and Fallahkhair, S., "Design Issues for Dual Device Learning: Interactive Television and Mobile Phone", Proceedings of the 4th World conference on Mobile Learning, Cape Town, South Africa,

2005

[4] Iain Darroch, Joy Goodman, Stephen Brewster and Phil Gray, "The Effect of Age and Font Size on Reading Text on Handheld Computers", Lecture Notes in Computer Science, Volume 3585, pp.253-266, September 2005.

[5] Filip Hendrickx, Tom Beckers, Nico Oorts and Rik Van De Walle, "An Integrated Approach for Device Independent Publication of Complex Multimedia Documents", Proceedings of the Ninth IASTED International Conference on Internet and Multimedia Systems and Applications(IMSA 2005), Honolulu, Hawaii, USA, August 2005.

[6] Wolfgang Mueller, Robbie Schaefer and Steffen Bleul, "Interactive Multimodal User Interfaces for Mobile Devices", Proceedings of the Proceedings of the 37th Annual Hawaii International Conference on System Sciences (HICSS'04).

[7] Meng-Huang Lee and He-Rong Zhong, "Design Considerations for Web-Based Interactive TV Service", Lecture Notes in Computer Science, Vol. 3579, pp.588-590, July 2005.

[8] Venkatakrishnan Balasubramanian Appiah and San Murugesan, "Adaptation of Web Pages for Hand-Held Devices", Lecture Notes in Computer Science, Vol.3579, Pages435~440, 2005.

[9] Karkkainen, L. and Larni, J., "Designing for Small Display Screens", Proceedings of the Second Nordic Conference on Human Computer Interaction, Arhus, Denmark, 2002.

[10]   Meng-Huang Lee and He-Rong Zhong, "The State-Machine Design for Video-on-Demand Services of Interactive Home TV", Proceedings of 9th IEEE International Symposium on Consumer Electronics, Macau, June 2005.

[11]   Meng-Huang Lee, "System Architecture for Interactive Home TV Services", Proceedings of IEEE International Symposium on Consumer Electronics, Reading, UK, September 2004.

[12]   Tom Beckers, Nico Oorts, Filip Hendrickx and Rik Van De Walle, "Multi-channel Publication of Interactive Media Documents in a News Environment", Proceedings of the Twelfth International World Wide Web Conference, 2005.

[13]   S. Van Assche, F. Hendrickx and L. Nachtergaele, "Multi-channel publication using MPEG-21 DIDL and extensions", Proceedings of the Twelfth International World Wide Web Conference, 2003.

[14]   S. Van Assche, F. Hendrickx and L. Nachtergaele, "Multi-channel publishing of interactive multimedia presentation", Computers & Graphics, 2004(5):193-206

[15]   Mark Butter, Fabio Giannetti, Roger Gimson and Tony Wiley, "Device Independence and the Web", IEEE Internet Computing, September/October 2002, pp. 81-86

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