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# Design of an IPTV-Based Digital Signage System

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***Abstract***

*Signage is one of the most commonly used methods of advertisement. There is no business that does not have a sign. Traditionally, signage is static, in that content of the sign can never be changed. Nowadays, they use liquid-crystal displays and light-emitting diode–based video displays so that digital images, video and even streaming media can be dynamically displayed. While digital signage systems are quickly replacing traditional signage, Internet protocol television (IPTV) systems are also widespread. Components of an IPTV system include a content management system and a broadcast management system, among others. These components of IPTV systems can be used to provide content to digital signage displays as well as IPTV terminals. Therefore, this paper proposes a digital signage system based on an IPTV system.*

***Keywords****: Digital Signage, Point of Access, Content Server, Smartphone*

## 1. Introduction

Nowadays, digital signage displays can be found in many places, such as the corners of major intersections, in buses, trains, buildings, shopping malls, airports, and so on. We cannot drive or walk around without happening to see digital signage players. Because digital signage can display dynamic multimedia content, whereas traditional signage cannot, traditional signage is quickly being replaced by digital signage [1].

As the demand for digital signage rapidly increases, research on this topic has also become hot. For example, mobile digital signage systems, open multimedia signage systems, automatic content collection and distribution, privacy protection, natural interaction between users and signage, audience detection, and many other topics have been studied [1].

One survey found that a large portion of studies related to digital signage have been performed by the Japanese, and it is possible that the digital signage industry will grow much bigger. Therefore, this paper selects a few of the most interesting research results and reviews them [1].

Digital signage systems (DSS) can display video and streaming media. Therefore, a DSS needs a content management system (CMS) that allows users to conveniently upload and retrieve video files. A DSS also needs a broadcast management system (BMS) that provides an environment in which users can conveniently edit display schedules, the statistics service, the category service, the content price management service, and so on. An Internet protocol television (IPTV) system that provides live television, time-shifted programming, and video-on-demand services to customers also requires a CMS and a BMS. Therefore, using the existing CMS and BMS of an IPTV system for a digital signage system can save a lot of resources, including hardware, software, and time. Therefore, this paper introduces the design of a digital signage system in which an existing IPTV infrastructure is incorporated. The proposed DSS is an open system, in that any authorized users can upload their digital content to the system and use any content in the system in order to display it on their signage players.

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## 2. Related Work

This section reviews digital signage systems. The advantages of digital signage over static signage include: 1) video content can be played, 2) dynamic images and texts can be played, 3) the content can easily be changed, 4) real-time video can be played, and 5) user interaction is possible. Therefore, many static signs are replaced by digital signage players. These digital signage systems either display high-definition colorful images or interactive content through which users can purchase tickets, coupons, and merchandise, or obtain useful information [1].

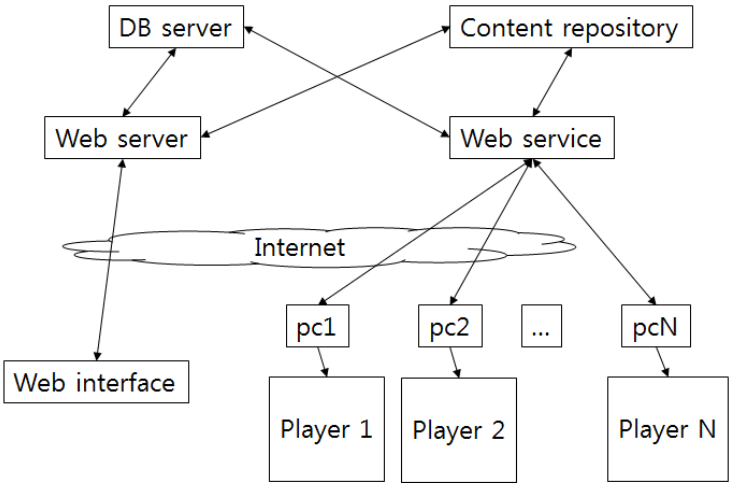


**Figure 1. The Architecture of the Digital Signage System Proposed by Sugiura *Et Al.* [2]**

A digital signage player can be offline or online. An offline player is equipped with a hard disk, and new content files manually copied onto the disk. An online player can receive a multimedia stream from the server and display it immediately. It can also receive burst multimedia content and save it in storage [1].

Sugiura *et al.* [2] proposed an open digital signage system to which many content providers can upload their content, and many players can access the content management system to utilize the stored content. The architecture of their system is illustrated in Figure 1.

Nowadays, people are exposed to advertisements displayed on digital signage players. There are also bidirectional signage systems where users can enter instructions to the system. People spontaneously use bidirectional signage systems in order to purchase tickets and coupons or to get useful information [1].

Bidirectional signage systems can also provide targeted advertisement services. Considering user, device, and content profiles, targeted advertisement displays the content that is most likely to attract people in the most effective way [1].

Yoon *et al.* [3] presented a digital signage system based on a service delivery platform (SDP). The overall configuration of the system is seen in Figure 2. The sales manager of a store (the seller) uploads advertisement content and sets the market banners using the content manager. The seller pushes advertisement content that is configured and edited by the content manager to the end users' mobile devices when the point of access (POA) detects a request. An end user can spontaneously access a POA and make a request for a service. The service provider accepts signage service requests from the sellers and creates signage services that meet sellers' requirements. While creating a signage service, the service provider may use the content provided by the content server. The content providers create

 

multimedia content for the seller and store the content in the content server. The network manager handles network and user information.

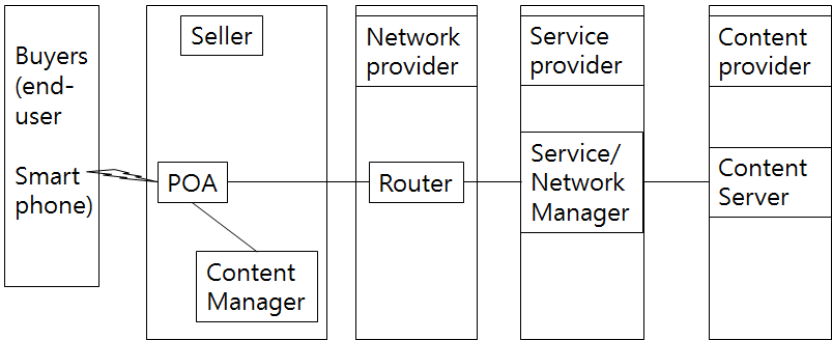


**Figure 2. Overall Configuration of a Digital Signage System [3]**

In this system, end users are accessing the signage system with their smartphones. Therefore, the system can guess the current location of the user and provide location-based advertisements. Their system contains a profile enabler that takes the user's preference and records it. With the help of the profile enabler, the system provides the targeted advertisement service [1].

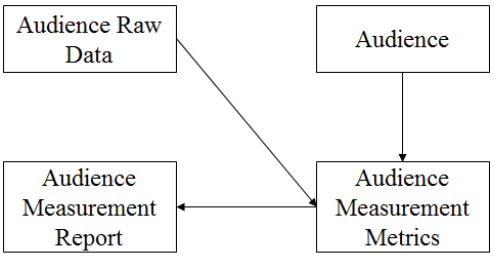


**Figure 3. Audience Information Extraction Steps [4]**

Recent development of information technologies and electronic displays has made digital signage services possible. Since digital signage displays advertisement content much more effectively than traditional signage, digital signage is quickly replacing traditional signage. Hyun *et al.* [4] presented an audience measurement procedure. Audience information-extraction steps are described in Figure 3. In the first step, sensor devices installed in digital signage terminals capture raw data, such as images, video clips, and sounds. Data are gathered by the analyzer and represented in audience-measurement metrics. The analyzer may collect data from interactive signage devices, too. Audience-measurement metrics are statistically analyzed further, and the results are reported in a form meaningful to humans [1].

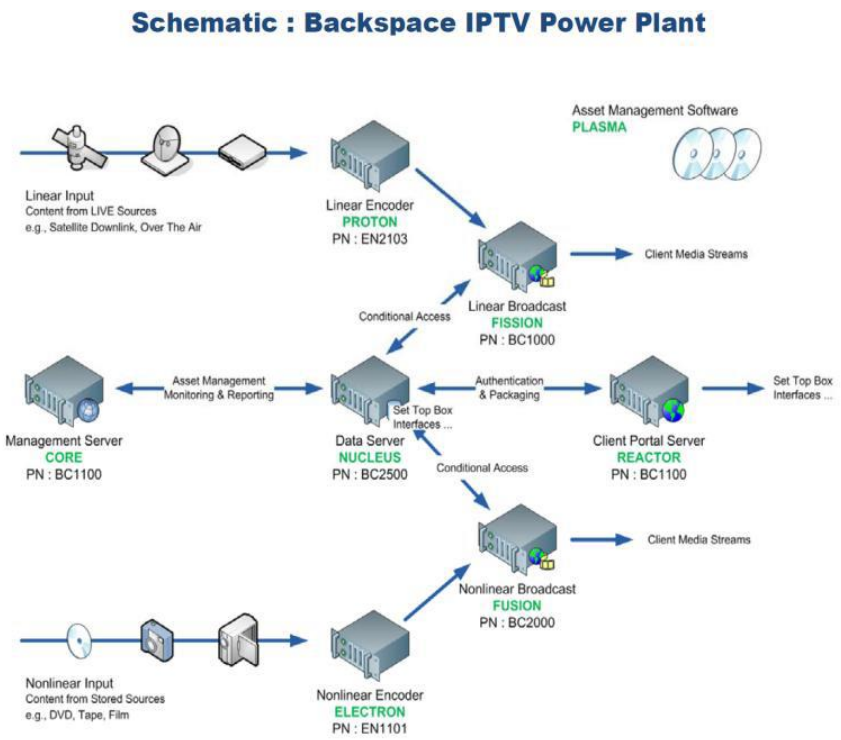


**Figure 4. A Schematic Diagram to Describe the Structure of an IPTV System [6]**

In running a digital signage system, creating or obtaining multimedia content to be displayed on the players is an extremely important but difficult task. Inoue *et al.* [5] proposed a digital signage system that automatically collects and distributes content. The main idea of their system is based on one source, multi-use (OSMU). Broadcasting systems, local governments, advertisement companies, newspapers, public institutions, companies, and factories probably have their own content for advertising their products and propagating their roles and events. Inoue *et al.* proposed a local content repository that collects existing content. This repository is linked to the digital signage content storage system, and the system distributes content from both the local content repository and the digital signage content storage.

Backspace is a company that provides IPTV services and IPTV system installation. Figure 4 describes its IPTV system architecture. There are two types of service a subscriber can choose through a set top box: one is live broadcast, and the other is video on demand (VOD). A live broadcast is served through linear broadcast. Linear broadcast sequentially pumps out two kinds of stream: one is from a satellite receiver, and the other is from a data server. The satellite receiver catches and passes the signals from TV stations, whereas the data server sends the selected multimedia content for linear broadcast. VOD services provide subscribers with a menu so they can select a video, then VOD streams the selected video to the subscriber. PROTON, FISSION, CORE, NUCLEUS, REACTOR, FUSION, and ELECTRON found in Figure 4 are Backspace's products. For example, the trademark CORE is the management server they sell [6].

## 3. Design of the IPTV System

This paper introduces the design of an IPTV-based digital signage system. Therefore, this section starts by designing an IPTV system that can easily be

 

integrated with a digital signage system. In order to achieve that goal, this paper proposes an open IPTV system with which users and organizations can easily open and run their own IPTV channels. Main components of the system are described in Figure 5. The system provides a web portal system so users can access the system, ask to open their own channels, edit programs for their channels, and file requests to air their channels. Representatives of organizations can also access this system through a web portal and open their channels.

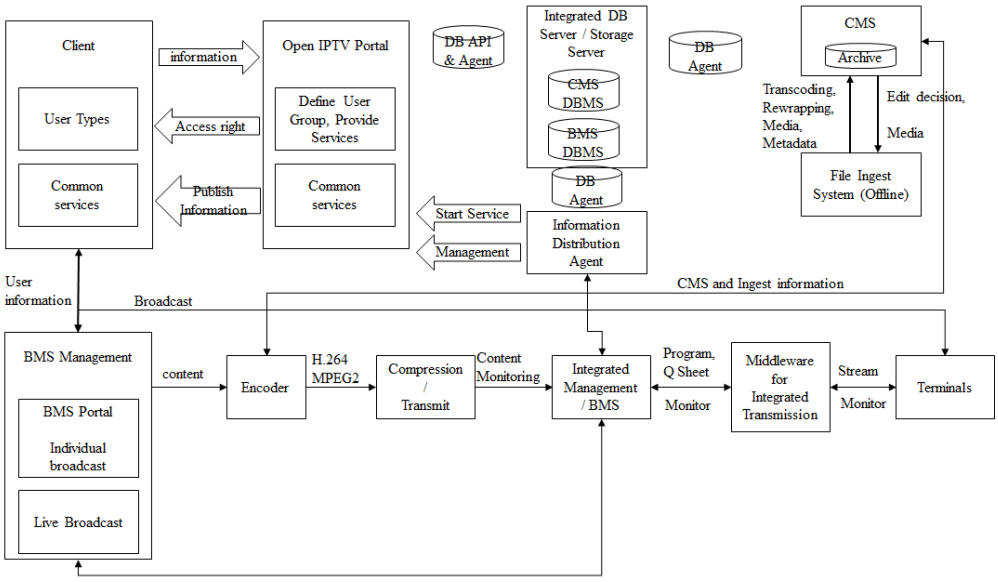


**Figure 5. Main Components of the IPTV System**

End users can access this system through the web portal using their smartphones, desktops, smart TVs, and tablet PCs in order to select and watch channels and videos. End users can also chat with others while watching channels, in order to exchange feelings and information about the video content. They can find detailed program information on smartphones, as shown in Figure 6 [7].


**Figure 6. Users Can Find Information about the Program and Chat with Friends [7]**

When users send requests to the server through the web portal to open their own channels, they have to provide their personal information. The server notifies them of their rights and responsibilities as channel owners. End users must also provide personal information when they subscribe to this system. After evaluating input information, the server assigns a particular role to each user. End user and channel user are examples of roles. An end user can be junior, general, senior, and so on. Depending on the roles of users, different resources and assets are assigned to them.

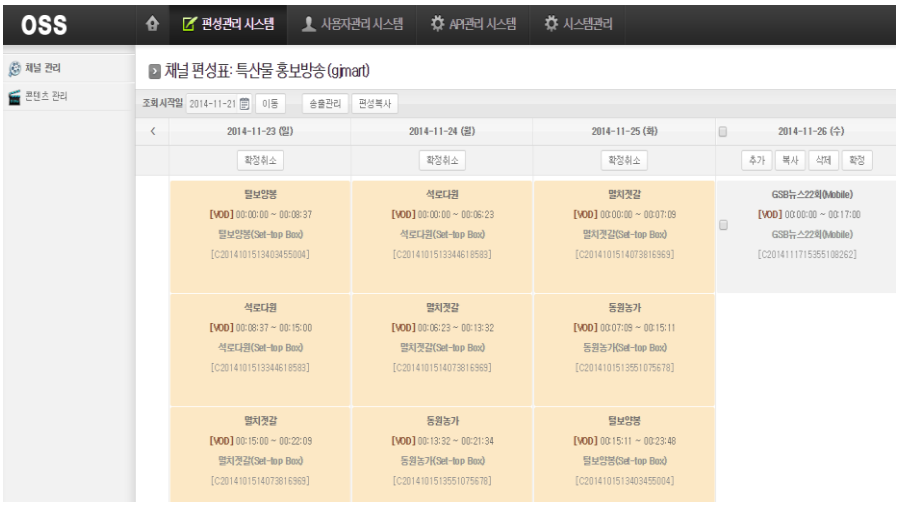


**Figure 7. A Screenshot of the Window for Editing TV Schedules [8]**

The server can handle 16 channels for individual users and 32 channels for group users, such as local governments. The server also runs its own channels. End users can watch these channels or enjoy the VOD service.

Individual users and organizations can run their own channels after obtaining permission from the system. This implies that they can edit a program for their channels. The web portal identifies the role of the user and provides the program editor shown in Figure 7 if the user is an operator of the channel. In the figure, programs for the "gjmart" channel are being edited [8].

Some services should be provided to all types of users. These services are handled by a "common services" component. Providing social network services, such as recommending current TV content to followers, publishing programs, information and legal responsibilities, and providing manuals are all examples of common services.

Users, roles, programs, personal information on users, and documents on legal responsibilities are recorded in a database. In addition to them, information on content assets is also recorded in the database, and the content itself is stored in an archive. Because there are so many video files stored in the archive, a content management system is needed, which can conveniently retrieve a video. In addition, the CMS should allow any authorized user to upload video files.

Therefore, the CMS performs user management, authority management, supplier management, content management, transcoding monitoring, and delivery monitoring. User management displays user (subscriber) information, searches for information with the user ID, creates and registers a new user, updates user information, and deletes a user. User information includes user ID, name, description, e-mail address, office phone number, mobile phone number, and other details. A pop-up button and a web page containing detailed information about the user are linked to the *Detail* function. Changing passwords and authority levels can be done on this page. There are many sorts of authority: basic authority,

 

administrator authority, authority to register and delete assets, authority to edit metadata, and delivery authority. The authority management function lists many different authorities, so an administrator can mark check boxes on the list to grant the authority to the designated user group (not to an individual user) [9].

The supplier management function manipulates information about subscribed organizations. A subscribed organization usually opens its own IPTV broadcast channel through the web portal system and uploads its own content to be made available to end users. The functions provided through supplier management are similar to those provided under user management. They are used to display, search, retrieve, update, and delete information [9].

The functions provided for content management are also used to display, search for, retrieve, update, and delete content information. Content information includes title, length (running time), status (available or not), details, preview, and delivery. The details item is similar to the details item used in the user information menu, however, this one includes content format and thumbnail items. Preview plays a low-resolution version of the content when it is clicked. Delivery transcodes the content into the H.264 format (for IPTV delivery) and saves it in the broadcast management system content storage [9].

The transcoding monitoring and delivery monitoring functions manipulate information in the transcoding and delivery functions, respectively. Delivery information includes registration status (done or not), error type, and delivery status, and users can request redelivery here. As the others do, these submenus also display, search for, retrieve, update, and delete information [9].

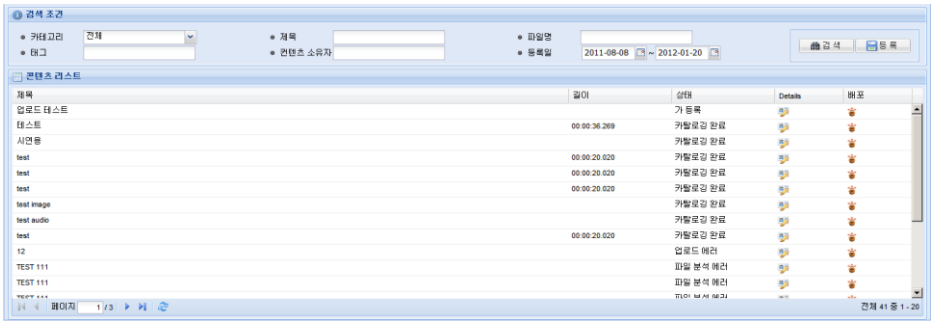


**Figure 8. A Screenshot from Content Management [9]**

The broadcast management system determines whether or not the users have permission to watch the designated content, to open their own IPTV station, and to manage the content. If the permission check is positive, then the BMS allows the user to enjoy the content, and updates the user's bill. If the user has permission to open his own IPTV station, then the BMS allows the user to register new content, retrieve and update the content information, and delete existing content. Similarly, if the user has permission to manage the content, then the BMS allows the user to register, update and delete it [10].

The functions of the BMS are categorized into two groups: basic functions and broadcast functions. The basic functions include Contents Registration, Contents/Metadata Update, Service Statistics, and Registration/Update of Related Contents. Broadcast functions include Category, Group, URL/IMG/Live/VoD, Subscribers, Content Price, Notices, News, Administrator Registration/Update, Administration Log, and Management of News/Notice [10].

Contents Registration provides functions to display content information, search information with a content description, create and register new content, update content information, and delete content. The system can register a content file in its

original format or after encoding it into the H.264 protocol. When a content file is registered, the group and the server to which it belongs can be designated, and a metadata aspect can also be filled out after uploading the content file. The content information includes content ID, content name, description, and the name of the manager of that content. Updating content information changes the existing content information. Deleting content deletes a content file and the metadata associated with it [10].

The Content/Metadata Update function allows administrators to register, update, and delete metadata. The metadata includes content title, genre, length, copyright, the thumbnail, producer, and actors. The function opens a content search window when it is clicked. In this window, users can select the metadata particulars and update or delete them. Deleting metadata does not delete the associated content file [10].

Content items are categorized. The BMS allows administrators to specify categories. A category function screenshot is shown in Figure 9. Users can select a category from the tree and edit the information from the selected category [10].

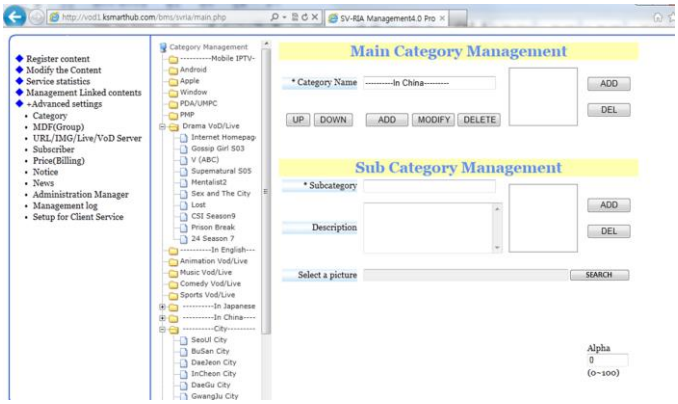


**Figure 1. Screenshot of the Category Function [10]**

## 4. Design of a Digital Signage System

The digital signage system is described in Figure 10. At the center of the system is the IPTV system and a studio with staff members, cameras, and other devices. A user of the signage system could be one of the IPTV system users. For example, the MICE broadcast is both an IPTV and a signage user. The MICE broadcast streams a live feed or a video to the IPTV system, then the IPTV system integrates the stream into the program and streams it to the signage players.

Another type of user is the ordinary user who just has some idea of what he or she wants to display on the signage players. The IPTV system receives ordinary users' requests, analyzes user requirements, and produces multimedia content for them. Then, the IPTV system streams or transmits the multimedia content to the signage players.

 

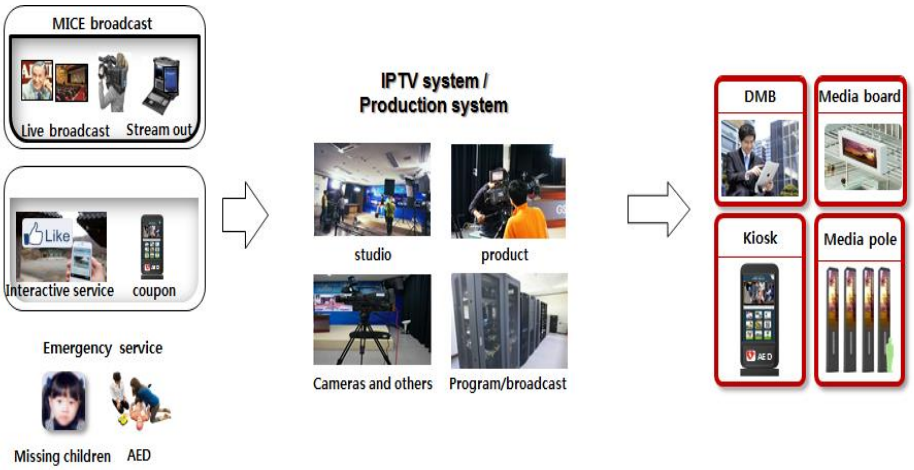


**Figure 10. A Conceptual Description of the Digital Signage System**

The signage system allows end users to participate in determining the program or schedule for display. They can send a message to the system expressing whether they like or dislike the signage content. Considering users' preferences, staff members can produce improved video content. End users are also allowed to purchase coupons through the signage players. There are three kinds of display terminal: media board, media pole, and kiosk. Among them, a kiosk is equipped with a touch-sensitive screen. By touching the menu buttons on the screen, end users can select a coupon and place an order. End users are also allowed to send emergency messages to the system. For example, when a child is missed, his/her parents can make a phone call or send a message to staff to tell them what happened.

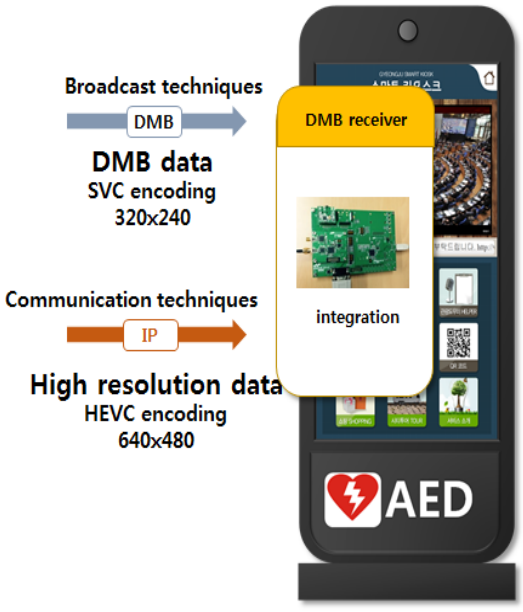


**Figure 11. The Kiosks Display High-Definition Video**

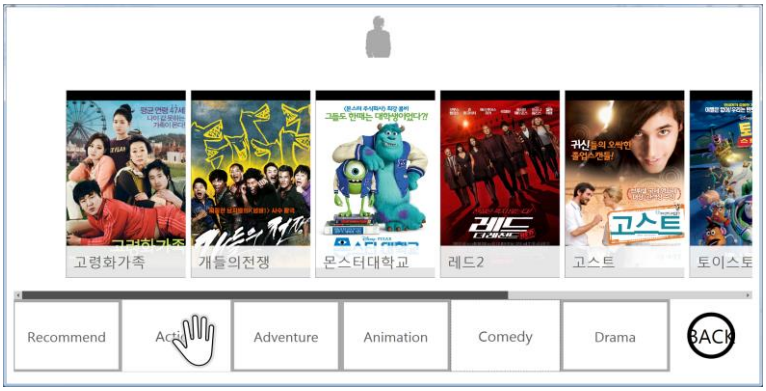


**Figure 12. A Genre is Selected [11]**

The signage terminals are connected to both the Internet and digital multimedia broadcasting (DMB), and can display high-definition DMB content, although the DMB content in Figure 11 is low resolution. The terminals receive both DMB data and high-resolution data and integrate them to produce high-definition video.

## 5. Conclusions

Digital signage is a hot research topic, and this paper reviewed recently published digital signage research results. Based on these research results, this paper introduced a design for an IPTV-based digital signage system. Kiosks, media boards, and media poles serve as signage displays, with kiosks equipped with touch-sensitive screens allowing two-way interactions. However, the other two kinds of terminals do not support two-way interaction.

For future work, attaching Kinect sensors to media poles and media boards will allow recognition of user gestures, such as an open hand, a closed hand, a stretched hand, and a completely stretched hand. Therefore, a media pole attached to a Kinect sensor can identify the menu button selected by the user, as shown in Figure 12 [11].

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