

Design of a Real Time Broadcasting System

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Abstract

Among new services recently introduced on the Internet, the real time broadcasting service that is provided by AfreecaTV and USTREAM is particularly eye catching. This paper introduces a design of a real time broadcasting system that provides Picture by Picture (PBP), Picture in Picture (PIP), caption, synthesis of videos, background music, flexible cue sheet manipulation, saving the video file at a server via FTP, and many other services. The existing real time broadcasting system shows two fixed windows: one for background image and the other for caster's video image. With PBP, we can flexibly divide the window into several small windows in order to display multiple images. With PIP and Chroma Key, we can obtain more natural video display from the background image and the real time video. In the existing real time broadcasting system, the number of background images is limited to one. It synthesizes it with the video from the webcam. We can improve this feature so that we can have many background images and choose any one of them during broadcast. We can even use a PowerPoint file for the background images in order to broadcast a real time lecture naturally. Furthermore, even another video can be used as the background image. This paper describes our design of such system in detail.

Keywords: *Real time Broadcasting System, PBP, PIP, Video, Webcam*

1. Introduction

As information technology develops, the prices of high performance personal computers decrease and as a result most of the people possess and use computers in their daily life. It is well known that human has the internal instinct of expressing oneself and the success of Youtube can be explained by this fact. Real time broadcasting systems such as AfreecaTV [1] and Ustream [2] are good examples of how businesses are taking advantages of this phenomenon.

Figure 1 shows a typical user interface of the real time broadcasting authoring tool of Afreeca TV. This is a closed one in a sense that the content can only be broadcasted by the computer where the content is produced and most of the fancy/advanced features of the tool are for sale. This paper designs an authoring tool that can be easily distributed for free to users who want to create and broadcast their own content.

The proposed authoring tool provides the following functions: dividing the window into a few small windows (picture by picture (PBP) and picture in picture (PIP)), compositing a webcam video stream with images or other video stream (Chroma keying), saving the webcam video stream into a file at a local storage or a remote storage, inserting background music into the webcam video, and inserting caption. This paper describes the user requirements and the design of the proposed system in detail.

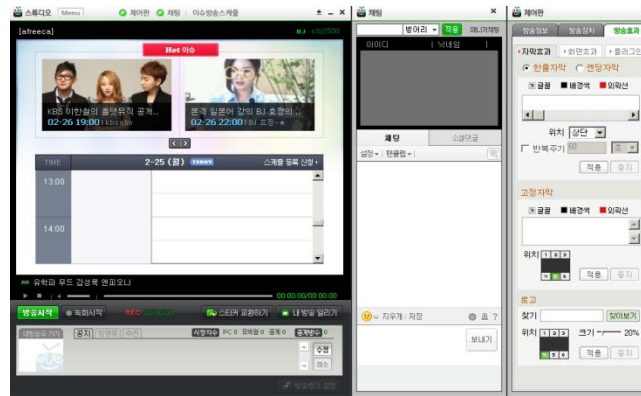


Figure 1. The Authoring Tool of Afreeca TV

2. Related Works

Ozaktas *et al.* and Kim *et al.* [3, 4] introduced methods of compositing real time camera image with virtual content. Our proposed solution is more advanced compared to theirs in a sense that it is distributed as ActiveX so that anybody can download and use it; moreover it is interconnected with social network services.

The video stream broadcasted and saved by our real time broadcasting system will be received by PCs, smart TVs, and smart phones. That is, the service provided by the system is a variation of one-source multi-use (OSMU) service. Lang *et al.* [5] suggested a reliable interactive content delivery system architecture for effectively transmitting and managing OSMU services through the use of heterogeneous devices in a convergence environment.

The video generated by our system can be saved locally and remotely at the content management system (CMS). The videos at the CMS can be searched and watched by subscribers. Kim, J. *et al.* [6] introduced an ontology based search and ranking method that suggest a content based on its semantic knowledge structure that describes core concepts and relationships extracted from the content. They defined four ranking measurements for suggestion: topic label coverage, topic completeness, relation complexity, and topic density.

It is desirable to automatically extract the index of the video that our system generates. Theodorou *et al.* [7] evaluated a few machine learning algorithms that have been successfully used in classification. That classification scheme consists of pre-processing, audio parameterization with established audio features, and classification to acoustic events. Then, they performed the experiments testing the classification scheme using the boosting technique with decision trees.

A personalized TV service focuses on broadcasting the shows that the subscriber wants to watch at the moment. For example, searching metadata to select the goal scenes of soccer play, editing those scenes and displaying the edited content only can be an example of personalized TV. In a bidirectional broadcasting service, transmitting data from the client to the server is possible. In order to provide a personalized and bidirectional service, user's profiles are used.

A metadata based personalized digital multimedia broadcasting (DMB) service model and DMB Electronic Content Guide (ECG) XML standard has been established by Telecommunications Technology Association (TTA). Using this standard, we can search a segment of a video. A segment search is required in personalized broadcasting.

The techniques that are used to display same content on a smart TV, a smart Pad, a smart phone, and so on are called scalable data service providing techniques. Scalable application descript language (SADL) is a language to describe scalable data service.

Mobile phones are connected to other phones and other devices through cellular networks and the Internet. Therefore, multimedia services can be simultaneously delivered to many mobile devices via the networks. Multimedia services deliver data to a mobile device as much as the traffic can carry and the buffer in the device allows. Therefore, the size of the buffer performs a crucial role in determining the performance of the system. Kang and Sha [8] analyzed Reed-Solomon (RS) based forward error correction (FEC). Then, they proposed novel analytic models for performance evaluation of RS coding.

In real-time multimedia service, broadcast transmission is used. Kim *et al.* [9] introduced a broadcast system architecture that guarantees 90% of packet delivery ratio. The system is a sort of server-client system. The server generates a media stream, chops it up into packets, and broadcasts them to the clients. When the system generates packets, it applies the forward error correction (FEC) to the packets considering the feedback from the client. A client receives packets, recovers the loss packets, and sends the average delivery ratio to the server.

3. Functional Requirements

Figure 2 shows the service flow of the authoring tool. A caster (a user who is taking his/her video and broadcasting the video) creates and broadcasts a video using the authoring tool. Then, the signal is delivered to the streaming server. The delivered signal is streamed out to the end user who selected this caster via the site user interface (UI) on a web browser. The authoring tool should be distributed as an Active X so that any web browser user can download and use it without rebooting or modifying the configuration files.

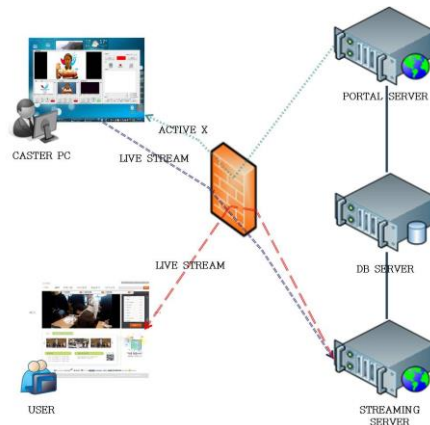


Figure 2. A Service Flow Diagram for the Proposed Authoring Tool

The authoring tool should provide functions of capturing video from the webcam, of compositing the webcam video with a background image and background music and the user interface of the tool as shown in Figure 3. At the top-left, we can see a window (called the main window) where the image that will be delivered to the user is displayed. At the down-left, we can see the reference image that will be composited with the webcam video. The buttons under the window are as follows: 'to the previous file', 'to the beginning if the opened file is a video', 'to pause', 'to the next file', 'to open a file (either an image file or a video file can be opened on this window.)', and 'to open the device' in the order of top to bottom and left to right. The next to the reference image is the webcam video. The next to this webcam video is the window for the background music.

On the right hand side, we can see three buttons labeled 'Screen Set-up,' 'Output Set-up,' and 'Environment Set-up,' with the 'Screen Set-up' button clicked. On the 'Screen Set-up' window, we can see buttons of 'Channel 1,' 'Channel 2,' 'Channel 1:2' and so on.

The 'Channel 1' button is to display the reference image on the main window, the 'Channel 2' button is to display the webcam video on the main window. The button labeled 'Channel 1:2' is to output PBP window as shown in Figure 4.



Figure 3. User Interface of the Authoring Tool



Figure 4. An Example PBP Window



Figure 5. 'Environment Set-up' Menu

Among the three buttons (labeled 'Screen Set-up,' 'Output Set-up,' and 'Environment Set-up,') the 'Environment Set-up' menu shown in Figure 5 should be explained. In this window, we can find textboxes labeled 'Channel 1 Folder,' 'Channel 2 Folder,' 'Background Music Folder,' 'Q-Sheet Folder,' and 'Folder for Saving the Generated Video.' The meaning of those textboxes is obvious from the labels. We can specify the folders by searching the computer.

4. Design of the System

The configuration of the proposed system is shown in Figure 6. A streamer generates a live video using the proposed real time broadcast authoring tool. The live video is transmitted to the streaming server and broadcasted to the users through the Internet. The video generated by the streamer can be transmitted to the content management server through the portal server in order to be saved. The monitor agent running on the portal server collects data about what the streamers and other users do and sends out data to the administrator through the monitor server so that the administrator can monitor streamer's broadcasting activities.

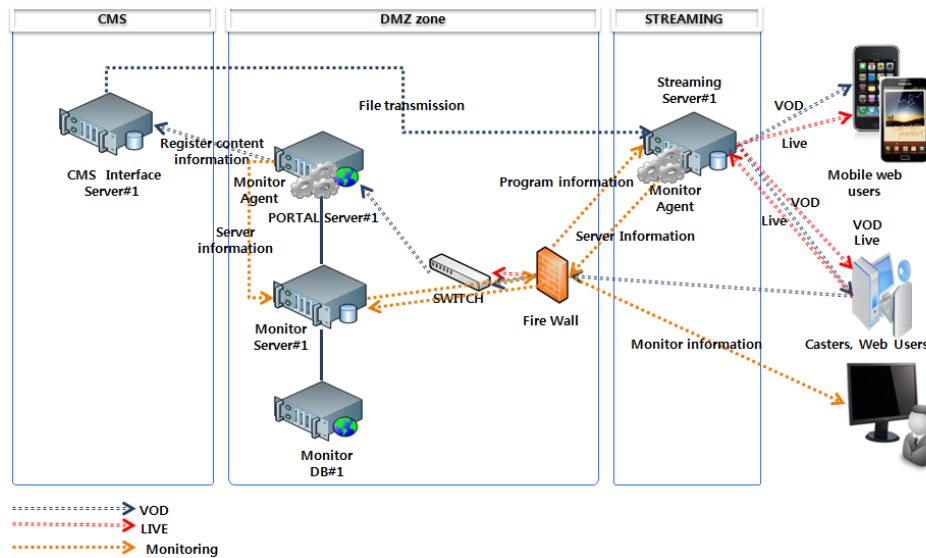


Figure 6. The Configuration of the Proposed System

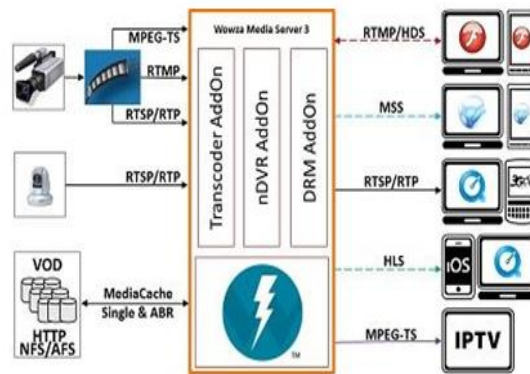


Figure 7. The Structure of WOWZA Media Server [10]

We are using WOWZA Media server as the streaming server. The structure of WOWZA is shown in Figure 7 [10]. The video signal produced by the authoring tool is transmitted to the server in RTSP, RTP, RTMP or MPEG-TS. The received signal is transformed into MPEG-2 or H.264 by Transcoder Addon of WOWZA, transformed into content cache that can be easily transmitted, and encrypted by DRM Addon in turn. When a user downloads the ActiveX, the system authenticates the user with his/her login information. At the end of broadcasting, the caster can save the video file.

Users should subscribe to our system before they broadcast their own video. In order to subscribe, a user has to access our web portal and click the 'Subscription' button.

Subscription process is executed in the 'Personal Broadcast' module. The process returns the user's information to the user, and the subscription is successfully done when the user acknowledges the information. The process of subscription is shown in Figure 8.

A subscribed user can broadcast his own video after getting an approval from the administrator. The process of handling a request for a Broadcast Jackie (BJ) is shown in Figure 9. The process is executed in the portal site. The subscribed user who asked for BJ is informed by e-mail when the request is approved.

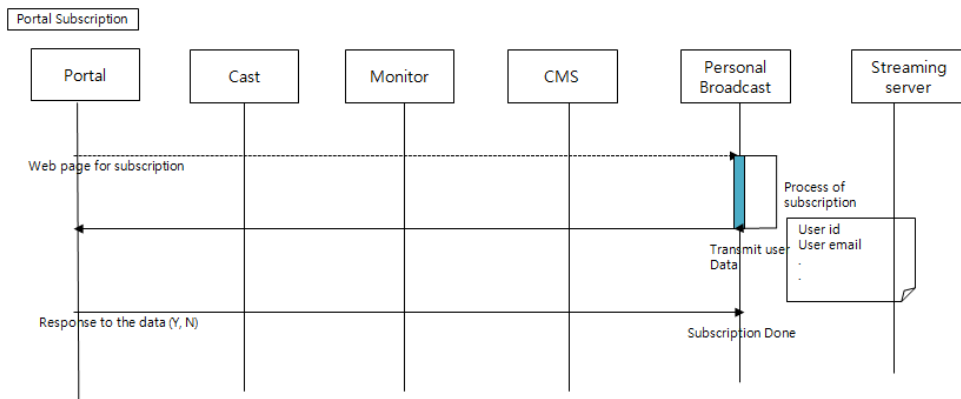


Figure 8. The Process of Subscription

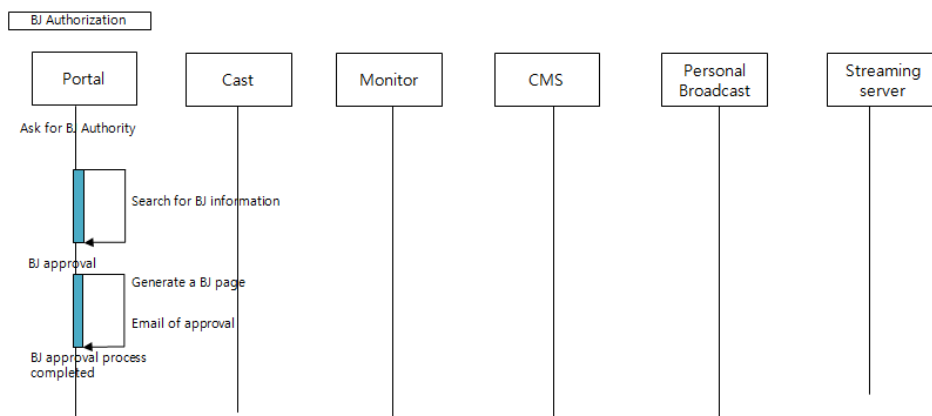


Figure 9. The Process of Handling a Request for a Broadcast Jackie

The video file that is generated by a BJ can be saved in CMS. The process of uploading a video file is shown in Figure 10. As it shows, a VOD file is inspected by the administrator before it is sent to the CMS. A video file arrived at the CMS is encoded into H.264 format before it is saved.

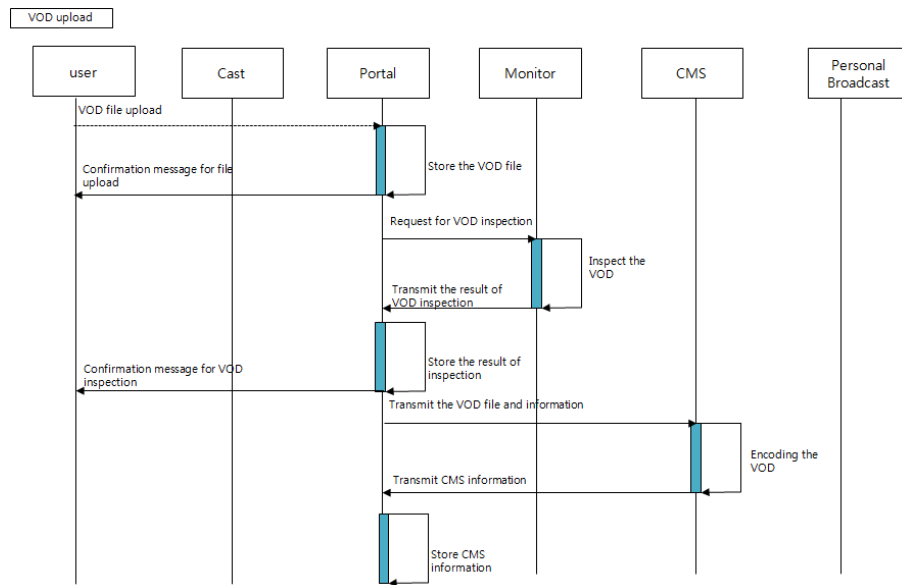


Figure 10. The Process of Uploading a Video File

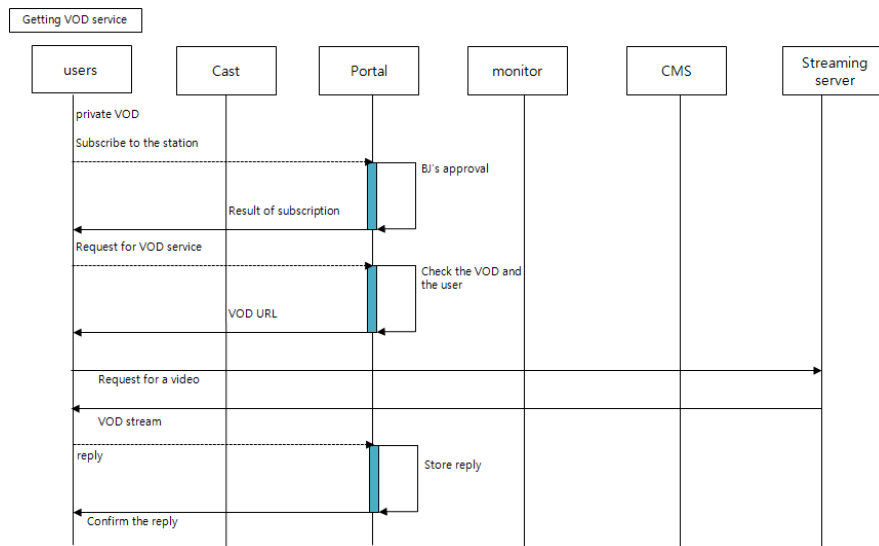


Figure 11. The Process of Getting VOD Service

The process of getting VOD service is shown in Figure 11. A user has to subscribe to the broadcasting station that is opened and run by the BJ. The client module running on the device (mobile or desktop) of the user obtains the URL of the video that the user wants to watch from the portal server. The client module requests a video stream to the streaming server with the URL. Users can write their opinion about the video to the portal.

5. Conclusion

A design of a real time broadcasting system has been introduced in this paper. Our design of the system, including the functional requirements, is described in detail. The proposed system is more advanced than existing ones as PIP, PBP, caption, cue sheets, and so on are allowed in the system.

Expressing oneself is one of the strongest instinctive desires that everybody has. As visual plus aural medium, video is one of the most attractive multimedia we can use. Enabling users to take their own video and broadcast the video live, our system will be

widely used by the users and contribute to boosting media industry. Therefore, we are planning to implement a practical real time broadcast system in the near future.

Acknowledgments

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