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A novel 3D streaming protocol supported multi-mode display

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ABSTRACT

With the development of 3D technology, many 3D commercial movies are being released widely. In addition to cinemas, some well-known commercial video websites have started to provide traditional anaglyph 3D broadcast services "red and blue color display." Owing to this trend, another multimedia revolution begins. However, there are too many choices of display technologies for users, such as anaglyph, gate-type, linear polarizer, circular polarizer and shutter, all of which typically require special monitors with different rendering methods. However, we cannot know what kinds of facilities will be adopted for the transmissions. Even with the support of different display technologies, there are still some technical problems because the same kind of rendering method cannot simultaneously support different 3D display technologies. Therefore, how to provide 3D multimedia services on the Internet becomes an important issue nowadays. This paper presents an efficient image compression strategy that provides services such as 3D, non-3D and even the free viewpoint video, and allows clients to select the compression strategies based on the types of the devices. Moreover, this paper proposes an algorithm that can optimize the packet priority for the transmission status while the videos are being transmitted on the Internet. Our experiments prove that this algorithm successfully integrates the image strategies with the packet priority and achieve "a multi-mode 3D transmission system."

1. Introduction

In the present day, the resolution of videos is becoming even more delicate. High-definition (full HD) televisions can be seen almost everywhere and the pores on a person's face also can be displayed clearly. However, in the future, to only improve the resolution of images is no longer meaningful because users are less willing to replace their equipment for better resolution. Due to this trend, many multimedia service companies began to look for the next killer application and it seemed that the success of commercial 3D films would be the most feasible alternative (Edwards et al., 2005; Goo, 2005). Nevertheless the popularization of 3D technologies might encounter many difficulties. First of all, there are too many implementation methods to achieve a 3D display, but each of them cannot support one another. In addition, there are still some problems, in which human factors are the most difficult ones to control. As for the current 3D technology including polarization, anaglyph and shutter, users inevitably have to wear the special 3D glasses, which is quite inconvenient for Asian countries with high percentage of glasses-wearers. Moreover, use of the 3D glasses might lead to dizziness in the viewer and many people thus cannot use 3D display monitors for a long time. For the time being, although many firms have proposed resolutions for 3D display, the price of 3D display equipments is still expensive (Carranza et al., 2003).

In 2009, services of high-quality video streaming were first released on the Internet. According to their environments, clients can freely choose a suitable resolution while playing videos. Along with the development of clouding technology, the Internet is bound to provide more diversified multimedia services. Besides high-definition video and audio, the popular 3D playback system is also offered. Some websites in fact have already provided 3D videos in the anaglyph playback mode and more choices, like free viewpoint videos, will be surely included in the near future.

Therefore, with the same video source, the service provider must offer all kinds of choices of playback modes and this might cause some problems in resource utilization. Different playback modes usually lead to different rendering results. To generate individual video streaming according to playback mode and resolution in advance will waste the hardisk space because the server has to save the same video streaming in different types and resolution, without including the interlace problem of polarized display. In order to solve these problems, this paper proposes a 3D video compression strategy that can support all playback modes of

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3D videos. By using our proposed algorithm, we can attain the following achievements:

(a) Our proposed compression strategy allows users to determine their own playback modes.
(b) Similar to H.264 SVC, when the network status is bad, this proposed architecture can adjust the resolution of 3D image transmissions, and even switch to 2D images according to the bandwidth.
(c) Our algorithm also has the quality of service (QoS) mechanism of 3D video transmissions. Higher priority is assigned to the encoded packets and all priority information will be based on IPv6 standard QoS functions.

The rest of this paper is organized as follows. Section 2 introduces some related works and researches. Section 3 explains the kernel of the proposed algorithm while the simulation and analysis is given in Section 4. The conclusion and our future target are illustrated in the final section.

2. Related works

2.1. 3D display technology

Color-difference 3D has hah the longest history because its imaging principle is simple and the cost is low. However, the quality of 3D images is not ideal and specific 3D glasses must be adopted to view 3D effects. By rotating the filter wheel to separate the spectrum, color-difference 3D uses different color filters to filter the image to generate two images. At present, the most commonly seen colors of filters are red/blue, red/green, and blue/green.

As with active 3D technology, shutter 3D technology achieves 3D effects mainly by enhancing the fast refresh rate of the images (at least up to 120 Hz). When the 3D signal is input to the display devices (such as monitors, projectors, etc.), image frames of 120 Hz will be generated sequentially and transmitted by infrared transmitters. The 3D glasses keep refreshing the images according to the images viewed by the right and left eyes and maintain the same frame numbers of 2D images. When the eyes of the viewers keep watching the fast image switches that cause the illusions, the viewers are able to experience the 3D images.

Polarized 3D, also known as polarization 3D technology, is a passive 3D technology, and the price of the glasses is much lower. Current 3D cinemas and LCD TV mostly use polarized 3D technology. Like the shutter, polarized 3D can be further divided into many kinds. For example, linear polarized 3D applied in the projector industry needs at least two projectors with the same performance parameters to achieve 3D effects. On the other hand, circular polarized 3D applied in the TV industry needs monitors with a refresh rate of 240 or 480 Hz. In brief, both the linear and circular 3D technologies allow users to see two different images by utilizing the features of light (Tanimoto, 2005).

2.2. H.264 SVC

Even with the presence of many error correction or compensation mechanisms, H.264/AVC cannot provide complete flexibility for video streaming services, especially in the wireless network environment, in which the changes are great and instant, and the playback capabilities of various equipments are also very different. For this reason, ITU-T VCEG and ISO MPEG cooperated together to form a joint video team, developed the novel Scalable Video Coding (SVC) based on H.264/AVC, and further redefined the composition of the images to be a layered structure, in which a base layer and one or several enhancement layers are included. While the base layer provides the video images of basic quality, what the enhancement layers provide are the images of enhanced quality. Nevertheless, the data in the enhancement layers can only be decoded based on the base layer. This means that the base layer is the most important part for the video streaming services. In other words, the decoder must receive the data of the base layer first and then improve the image quality with the data in the enhancement layers. The adaptive encoding architecture of H.264/SVC can be divided into three dimensions: Spatial Scalable, Temporal Scalable and SNR Scalable.

In the following section, we will introduce the three dimensions in detail (Fig. 1).

2.3. H.264 MVC

Although H.264 already has SVC to apply to network services, by foreseeing the future of 3D display technology and free viewpoint TV, JVT established the codec of H.264 MVC, namely H.264 Multiview video coding (Kilner et al., 2007). As the extension of H.264, the purpose of H.264 Multiview video coding is to adjust the compression rate of images to the lowest to prevent an excessive

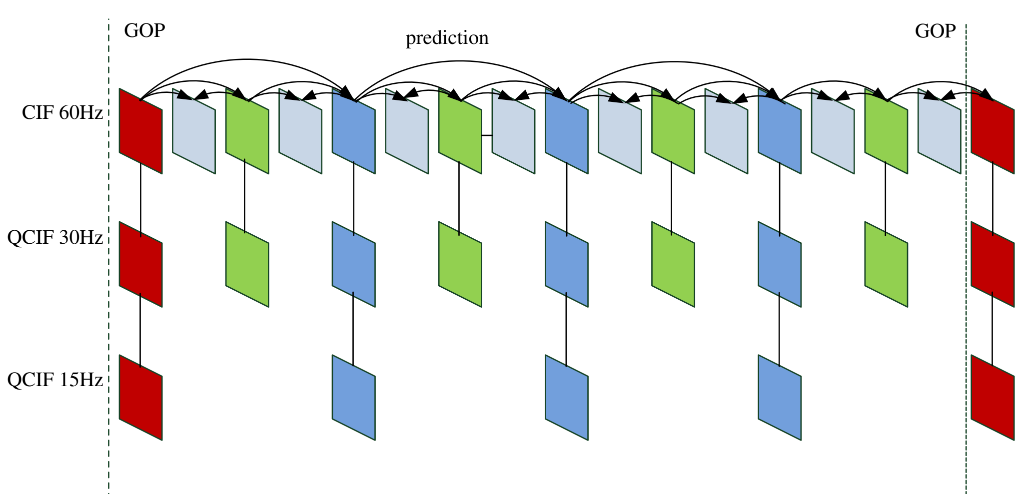

Fig. 1. H.264 SVC encode method.