2008－MPS－70 (2)
2008／7／14

Real-time 3D Movie Generation by Anaglyph for Live Streaming

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Abstract

Stereographic pictures are in the public limelight because of the recent innovative improvement of PCs. With high performance computing, image processing is no longer a hard task. Nowadays, stereographic movies come under the spotlight. The current PCs are so powerful that real-time creation of movie is possible. Meanwhile recent broadband networks enable the streaming of various contents. Especially, live streaming movies are used in various fields. In this paper, we propose real-time 3D movie generation by anaglyph for live streaming. Using two USB cameras, each captured image is filtered to composite stereographic image in real-time, and resultant 3D movie is immediately delivered by live streaming. Some experimental results validate that our system is enough practical.

アナグリフ動画ライブストリーミング配信の実現

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概要

近年，パソコンの革新的な発展に伴い，立体画像は世間の脚光を浴びている．高性能計算機によって，画像処理はもはや難しい処理ではない．このような状況において，立体動画像は特に注目を集めている．最近のパソコンはとても高性能であるためリアルタイム動画生成は十分行えるようになっている．さらに，近年ブロードバンドネットワークは様々なコンテンツのストリーミングを可能としている．特に，動画のライブストリーミングは様々な分野で活用されている．本稿では，リアルタイムでアナグリフによる３Ｄ動画像を生成し，ライブストリーミング配信するシステムを提案する．提案システムでは，*2* 台の *USB* カメラを使用することにより，それぞれのキャプチャ画像が，リアルタイムで立体画像に合成するためにフィルタリングされ，生成された３Ｄ動画像が即座にライブストリーミング配信される．また実験によって，自ら提案したシステムが十分実用的であることも示す．

1 Introduction

By recent broadbandization, streaming movies are widely used in video sharing websites such as YouTube. In addition, real-time information delivery systems, for example, live broadcast, monitoring, virtual meeting, traffic information and investigation at the scene, are very popular. Such real-time delivery movies are usually in the form of 2D. At the same time, 3D movies are widely used at various amusement facilities. We believe that real-time delivery of 3D movies will produce other effects to conventional real-time movie delivery systems. In this paper, we propose an anaglyph based 3D movie generation method in real-time so that it can be delivered concurrently. Anaglyph is the cheapest among 3D movie generation methods and easy to watch the 3D movies by binocular disparity. Live-streaming is chosen for real-time delivery. By using this model, not only raw movies but also CG movies can be used.

In section 2, we describe several stereographic movie generation techniques. In section 3, we illustrate the processes of real-time anaglyph movie generation and its algorithm. In addition to, we explain a lives streaming delivery process. To validate the proposed system and algorithms, we show experimental results in section 4.

2 Anaglyph Movie

Streography is be able to realize by using Anaglyph.

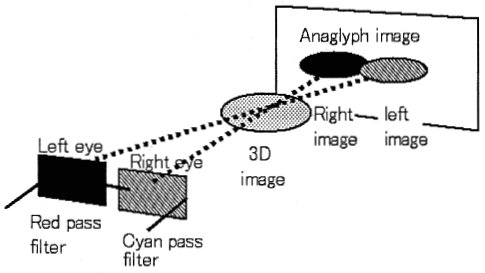

Figure 1: anaglyph filtering

Anaglyph is known as the two color (typically red and blue) glasses method for stereographic images. 3D images are generated by the two color filters to obtain binocular disparity. Stereographic movie is also generated with the anaglyph method where each frame of the movie is an anaglyph image. The principle of anaglyph is quite simple. Using two images for left and right eyes, an anaglyph image is encoded. To decode the anaglyph image into left and right images, the two color glasses are used as filters. The two color glasses use to be filters for removing red and blue color to generate a monochrome image. Recently, the two color glasses consist of red and cyan (blue and green). The red-cyan glasses can generate anaglyph images with three primitive colors. In practice, the right eye image is filtered to remove blue and green, while the left eye image is filtered to remove red. Fig. 1 shows the filtering image by cyan-pass and red-pass filters.

The anaglyph method has several advantages. First, it is the most inexpensive method for stereographic movie. The two color glasses are very cheap and any special devices are not needed. In addition, movie can be projected to most screens. Meanwhile, anaglyph images have restriction about color information because of the color filters [1].In addtion to,existing anaglyph generated softawres are not able to process in real-time. In this paper, we select the anaglyph method since we need cheaper deliver live streaming.

3 Real-time Anaglyph Filter

In this section, we propose a real-time anaglyph filtering method.

We implement real-time anaglyph filtering by C++ on a PC with Windows XP. As the development environment, we use the following libraries.

- OpenCV v1.0(Intel Open Source Computer Vision Library)[2]
- DirectShow

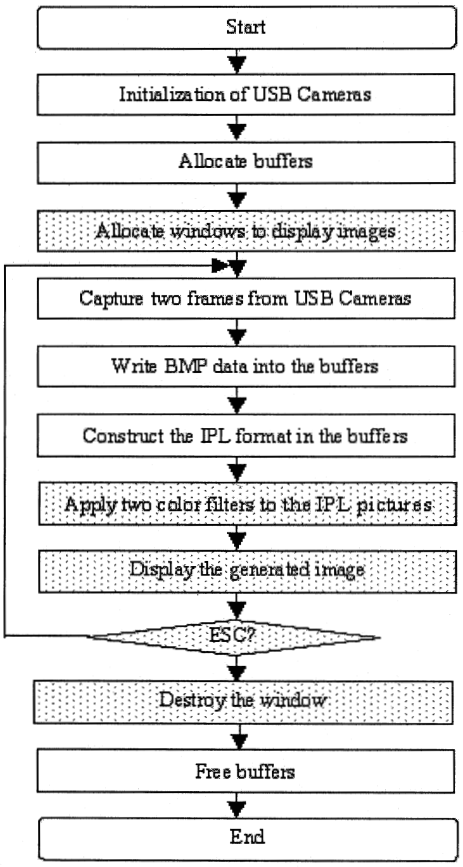

Figure 2: Program Flow

- Microsoft DirectX SDK(June2006)+ DirectX 9.0[3]
- EWCLIB 1.5 (Easy Web Camera LIBrary)[4]

Figure 2 shows the program flow for our implementation of anaglyph filtering by using OpenCV and DirectShow. White and gray boxes are processes with DirectShow and OpenCV, respectively. DirectShow is used to capture images from two (left and right) webcameras. OpenCV is used to generate and display the resultant anaglyph movie.

Initialization of two USB cameras and allocation of buffer space are performed with DirectShow. Using OpenCV, allocation of image areas and creation of a window are performed with cvCreateImage and cvNamedWindow, respectively. Then, images are captured from two USB cameras, and their bitmap information is stored

into the buffer by a DirectShow function.

$$\begin{aligned} out\_anaglyphR &= left\_imgR \\ out\_anaglyphG &= right\_imgG \\ out\_anaglyphB &= right\_imgB \end{aligned}$$

where left_img, right_img, and out_anaglyph represent left source, right source, and output image, respectively. RGB represents red, green and blue channels. The expression is applied to each input pixel. The program is terminated with deallocating the USB cameras and buffer memory when Esc-key is pressed.EWCLIB is used as a library for DirectShow.

Streaming delivery is a method to transform media data by packet.In this paper, we adopt the streaming delivery for real-time anaglyph movie distribution. For anglyph movie streaming delivery, we use the following tools.

- ManyCam
- Adobe Flash Media Server2
- Adobe Flash Player
- Adobe Flash CS3 Professional

ManyCam [5] is a multifunctional free software tool for streaming delivery using web cameras. It provides a virtual camera, which is used as a window for the output anaglyph movie, so that the snapshot of the desktop or the window is delivered in real time.

Flash Media Server2 (FMS) [6] is adopted to construct a scalable streaming server which distributes on-demand or real-time audio and video contents to clients. In this paper, we adopt the free developer version of FMS of which bandwidth is no limitation and the maximum number of concurrent connections is ten.

Flash player is widely used without any special plug-in and the percentage of PCs with Flash player is more than 90% in the world. Since our streaming delivery is based on the SWF form, Flash player is suitable for most platforms. We make use of Flash CS3 [7] to generate flash contents for servers and clients.

Figure 3 describes the following procedure of live streaming delivery.

1. anaglyph filtering to each image captured from two USB cameras in real-time.
2. Select a sequence of images by ManyCam as virtual camera, and send the virtual camera output to Flash CS3.
3. CS3 sends anaglyph images to FMS
4. CS3 generate SWF to be sent to client.

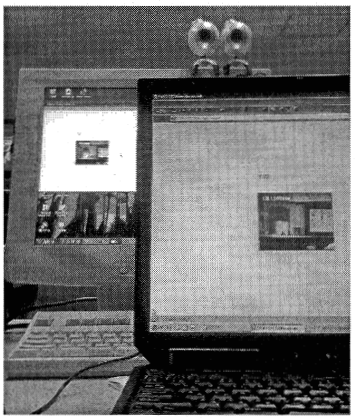

Figure 4: Experiment

5. The client executes the SWF to request the streaming, and FMS send the stream movie with RTMP.
6. Flash Player displays the stream movie.

Figure 4 demonstrates the real-time anaglyph live streaming. The front PC is the server, and the back PC is a client PC. The front PC has two USB cameras.

4 Experiment

In this section, we perform some experiments to measure the time for anaglyph movie generation for live streaming. Additionally, we show experimental environment and experiment results.The server PC has a processor of Pentium Dual-Core with 1.6GHz and 1GB memory. The USB camera, CMS-V20SETSV, provides the resolution of 640 by 480 pixels, and the maximum frame rate of the USB cameras is 30fps. We use a typical PC as a client. The server and the client is connected by 100Base-T Ethernet.

We measure the anaglyph movie generation time of 100 frames from each camera. Table 1 shows the average time of capturing, compositing and displaying two (left and right) images. The sum of the three stage processing times is 22.1ms per resultant anaglyph frame, which is equivalent to the frame rate of 45.2fps. In this experiment, the maximum frame rate of USB cameras is 30fps, which is almost equivalent to the frame rate of NTSC. Therefore, we confirm that anaglyph movie generation is achieved in real-time.

The generated real-time anaglyph movie is immediately taken by ManyCam to use a virtual camera. The output of the virtual camera is fed to FMS to perform the live streaming. The server PC is connected to a client PC by typical 100Base-T Ethernet, not a gigabit

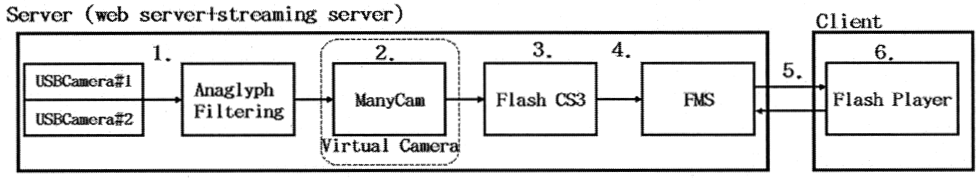

Figure 3: Anaglyph Live Streaming Architecture

Table 1: Anaglyph Movie Generation Time

	DirectShow+OpenCV					NTSC
	capture		composition		display	
	left	right	B&G filter	R filter		
Processing time [ms]	2.89	2.90	9.87	5.56	0.90	33.37
Frame rate [fps]	45.21					29.97

network. During the live streaming delivery, we measure the usage rate of the network. It shows the network usage rate for 30 seconds during the live streaming delivery and the average rate is 0.19%, namely the bit rate is 190Kbps. The bit rate is quite low because the target does not move so much. Although the bit rate is completely up to the target movement, the experiment indicates that the live streaming delivery of real-time anaglyph movie is fully possible.

5 Conclusions

In this paper, we proposed a real-time 3D movie generation method by anaglyph and its live streaming architecture. We used OpenCV and DirectShow to implement the real-time anaglyph movie generation with USB cameras. We also use ManyCam, Flash CS3, and FMS to construct a live streaming server.

We performed experiments to validate our real-time anaglyph movie live streaming. It takes 22.1ms to generate a frame of anaglyph movie, and the live streaming required a quite small bit rate of 190Kbps. Considering the low bit rate of live streaming, our real-time anaglyph movie live streaming is very practical.

In future work, we plan to extend our real-time anaglyph movie live streaming to a user-controllable system.

References

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[6] Adobe Flash Media Interactive Server2: http://www.adobe.com/products/flashmediaserver/

[7] Adobe Flash CS3 Professional: http://www.adobe.com/products/flash/