Basic Match Move Realization

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Thank for the lead and the research experience sharing by Hung-Hsiang Lin and Shih-Hao Hsiung, my seniors in Computer Science department in National Taiwan University by two years, I continued my research progress from last semester.

First, I realized the content of Epipolar Geometry, which is a necessary tool and an important concept in the topic of match move. Then, I kept surveying several papers about match move and reported how much I had absorbed and what I still felt confused to Hung-Hsiang Lin and Shih-Hao Hsiung once a week. Also, my classmate Yung-Hsiang Yang and I presented each of our weekly surveying and research progress to them. For him, the topic was about "Facial Expression"; for me, I felt the paper "High-quality video view interpolation using a layered representation[1]" stimulated my interest the most. Therefore, I started my research and implementation in this semester.

Content:

In the paper, the main goal is to interpolate videos from several synchronized videos shooting from difference angles. The following figures in the paper show the idea:

![Figure showing the concept of video interpolation](image)

With the information from both right and left images, we are able to interpolate the middle, missing image.

Thus, at the very beginning I needed to perform blurring in synchronized frames in order to retrieve blurred images for the following color segmentation. The images below are the sample color segmentations by myself.
After copying with color segmentation, the next step was to do disparity initialization. But before this, there is a problem to solve first. The data set I used was different from what was adopted in the paper. That is, first I chose to film my own data set/videos and picked synchronous frames from those videos. I also tried the method that filming a single video and moving horizontally at the same time so as to retrieve images containing the same objects from different angles. Continuing the latter approach, I used "voodoo"(a software for camera tracking) with SIFT to find the feature points from frame to frame. In this way, the problem of Epipolar lines could be simplified more easily(described later). The feature tracked images are as below:

With the help of horizontal frames from a video and the tracked data from voodoo as reference, the following disparity initialization was computed.
As the figures show, my disparity maps were calculated from the information in color segmentation. A disparity map was mainly created by comparing two neighboring color segmentation images and self color segmentation image. Thus, we need three images, namely self and two neighbors, to compare and create a disparity map.

Until this far, I completed:
1. Image Color Segmentation
2. Disparity Initialization

The following works after disparity initialization are not completed yet. Here are those works:
1. Disparity Refinement
2. Disparity Smoothing
3. Matting, Rendering

Discussion and Q&A:
When I was implementing this paper and doing research on the topic of Match Move, many things did not go smoothly as I thought. Perhaps it is because this is my first experience doing my own research. There are things unknown as threshold in this area to me, waiting me to dig out by myself. Besides, when implementing the concept in the paper, I should have considered more about the potential problems of future works, instead of insisting on my ideas, such as the fact that I chose to film a video as moving horizontally. I was supposed to
use the data set the paper adopts since the video content I shot while moving might not be perfectly horizontal. More precisely, for the lack of adequate equipment, the moving process of video shooting was not guaranteed to be a hundred percent horizontal. But I am glad because I learned that being creative is good, but sometimes it needs to come with well consideration.

In the implementation steps, sometimes I came up with my own ideas and could not wait to realize them. As the above description goes, the error from horizontally video shooting made some error handling necessary. Therefore, I had to seek if there was any way to correct that error and indirectly reduce unnecessary redundant works in the future. One method I found and implemented was to insert Image Rectification between the steps of Image Color Segmentation and Disparity Initialization. By doing so, I could rectify the frames from my horizontally shot video and present them as the reference images for Image Initialization. As to the process of Image Rectification, I implemented the algorithm with C/C++ and OpenCV 2.0 library to complete this step. Here OpenCV taught me a lesson as well. Sometimes we need to be careful when using open sources/libraries, because those sources are not always perfectly programmed. This fact might produce unexpected errors or even mine bugs into your program, cumulating errors and affecting the final results. Given the preciseness issue of Image Rectification, I chose to re-shoot my data set/video more carefully to avoid error from Image Rectification at last, instead of solving the unnecessary errors.

During this research year, an interesting invention went to the market, the infrared depth camera—Kinect. As the device came out, I was considering if I should stop this research direction and start all over on other. However, after retrospecting and discussing with others, I decided to continue the topic of color based match move because there are still obstacles that Kinect cannot pass, such as the depth of reflective materials and that of objects too far away. I believe the perfect depth measure requires both infrared information and color consideration in the future. That is why I was still on the track of color based match move.

This undergraduate research is my first research experience in college, and I want thank my senior classmates, Hung-Hsiang Lin and Shih-Hao Hsiung, and also my peer, Yung-Hsiang Yang, for accompanying me and discussing my progress. During this research, I encountered many problems to be solved and some bugs to be removed from my program. There were times I was forced to give upon my whole algorithm in order to reach the original objective, especially after debugging. Perhaps my results were not pretty ideal as a whole, and the process of research and paper implementation was not perfect neither, but I learned the spirit of doing research and the attitude of corporation from the self-solving and group discussion sessions. Because sometimes it is hard to solve a problem by oneself. Even a simple problem could contain blind points
for someone, and that is why we need others' knowledge and experience to create win-win situation, paving the shortcut to our goals.

In sum, no matter the results of my undergraduate research are satisfying to me or not, I felt happy and participated in the researching and the learning process. I also want to thank my advisor, Prof. Ming Ouhyoung, for enlightening my thinking in the meetings on every Thursday. Professor Ming Ouhyoung always teaches us to think profoundly and creatively and equips us with the ability to truly solve our problems, instead of being narrowed in the implementation or the contents in papers. Thank you again, Prof. Ming Ouhyoung.

Reference: