IMAGE-BASED SEQUENCE MATCHING FOR TIMELINE SYNCHRONIZATION OF VIDEOS

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ABSTRACT
To create a panoramic video, basically, timeline synchronization of input videos is required. This is because spatial matching of frames taken at the same time creates a seamless panoramic video. Therefore, in this paper, we propose a method to synchronize timelines of two videos recorded in a specific environment through brute force sequence matching. Experimental results of our proposed method show that the timeline synchronization accuracy within 2 frames is obtained.

Keywords: timeline, synchronization, sequence matching, SURF

1. INTRODUCTION

Recently, panoramic video creation technology has been developed for a wide range of events such as soccer and performance[1]. To create a panoramic video, basically, timeline synchronization of input videos is required. This is because spatial matching of frames taken at the same time creates a seamless panoramic video. Therefore, in this paper, we propose a method to synchronize the timeline of two videos through image-based sequence matching. And this method is aimed at recorded videos with following characteristics.

1. Camera can be panned and tilted.
2. For the forward event, both cameras are positioned in parallel.
3. The movement of the object is included in both videos.
4. Both videos are recorded at the same time with reasonable accuracy for the same event.
5. There are some overlapping areas in both videos.

2. PROPOSED METHOD

In two input videos, one video is referred to as the reference video and the other video as the target video. A sequence is defined as k consecutive frames. Then, timeline synchronization is performed through the following brute force sequence matching process based on image characteristics.

1. The sequences are set at i frame interval for the reference video and j frame interval for the target video
2. Repeat steps A to C for all sequences of the reference video.
   A. Calculate the similarity between the sequence of reference video and all sequences of target video.
   B. Select the sequence of target video with the highest similarity.
   C. Accumulate the number of frame difference of two sequences in the count table.
3. Synchronize the timeline with highest frequent value in the count table.
Sequence similarity is measured by SURF[2] algorithm based descriptor matching between frames in the same order. Euclidean distances of each feature point can be obtained by matching of two frames. If the Euclidean distance is less than a certain threshold value, it is called a reliable match, and the number of reliable match is set as the similarity score.

3. EXPERIMENTAL RESULTS

The proposed method was experimented in a test set. The length of the two videos in the test set is 233 and 263 frames. The camera of the reference video is panned to the right and the camera of the target video is tilted upward. In the proposed method, the sequence length \( k \) is set to 30, and the inter-sequence interval \( i, j \) is set to 5.

Table 1 shows the table created by the proposed method.

| value | -90 | -75 | -65 | -60 | -55 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5  | 0   | 5   | 10  | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 95  | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| count | 1   | 2   | 2   | 2   | 1   | 1   | 1   | 1   | 2   | 4   | 2   | 2   | 1   | 2   | 2   | 1   | 2   | 2   | 2   | 1   | 2   | 2   | 2   | 2   | 1   |

We used the highest frequent value of -35, which is the frame offset of the two videos, to confirm that the time synchronization was performed correctly as shown in Figure 1.

![Figure 1. Timeline synchronization result through proposed method](image)

4. Conclusion

We propose a method to synchronize the timeline of two videos to generate panoramic video. The proposed method performs a lot of sequence matching between two videos to select the frame offset with the highest frequency. In the proposed method, we could synchronize the two videos within 2 frames.

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