

An improved key frame selection algorithm on sub shots

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Abstract. The algorithm based on multi-frame average is the classical algorithm in all kinds of key frame extraction algorithms. This method has better sense on averaging the extracted key frames. But it can only extract one frame at once, which limits the reflections about changes in the content of the lens.

This paper, combined with changes in the content of the frames, proposes a dynamic frame average algorithm making use of sub-lens. This algorithm can extract the appropriate number of key frames based on changes in the content of the lens, and reflect the changes in the content of the lens better.

Introduction

The algorithm based on multi-frame average is divided into static frame average algorithm and dynamic frame average frame algorithm[1].

The static frame average algorithm[2][3] extracts a frame closest to the average histogram value of all frames as the key frame, this algorithm is simple, but it can't reflect the changes in the content of the lens well.

The dynamic frame average algorithm divides dynamically and extracts the sub shots of key frames by comparison with the inter-frame difference at first, then selects the most representative video frame of the sub shots by the average frame method[4]. Otherwise, according to the comparison result between inter-frame difference and the threshold, it adjusts the length of sub shots timely to reduce the number of key frames[5]. This algorithm not only has a good sense on averaging the key frames, but also controls the number of key frames extracted from the shots better. But this algorithm is relatively complicated on the amount of calculation.

Design of the improved key frame extraction algorithm

This paper, combined with changes in the content of the frames, proposes a dynamic frame average algorithm making use of sub shots, the main steps are as follows:

This paper makes such an assumption: because the frame step l is taken relatively small, the sub shot boundaries are not existed in the lens of final l frames. We suppose there are n video frames in one shot.

- 1) The first frame of lens is selected as the key frame, set $m_1 = 1$;
- 2) Set $k = m_1$;
- 3) Set $k = k + l$;
- 4) Determine whether the formula $k \geq n$ is established;
 - A. If established, then set $m_2 = n$, calculate the average histogram from frame m_1 to frame m_2 , denoted as \bar{D} , and select the frame closest to the average histogram value of between frame m_1 and frame m_2 as key frame, jump to 16);

- B. If not established, then calculate the histogram difference between k frame and the reference frame, denoted as d_{k,m_1} ;
- 5) Determine whether the formula $d_{k,m_1} > T$ is established;
- A. If established, continue to the next step;
- B. If not established, return back to 3);
- 6) Set $k = k - 1$, calculate the frame difference between frame k and the key frame;
- 7) Determine whether the formula $d_{k,m_1} > T$ is established;
- A. If established, return back to 6);
- B. If not established, set $m_2 = k$, continue to the next step;
- 8) calculate the average histogram from frame m_1 to frame m_2 , denoted as \bar{D} , and select the frame closest to the average histogram value of between frame m_1 and frame m_2 as candidate key frame p , set $k = m_1$;
- 9) Set $k = k + l$;
- 10) Determine whether the formula $k \geq n$ is established;
- A. If established, then set $m_2 = n$, calculate the average histogram from frame m_1 to frame m_2 , denoted as \bar{D} , and select the frame closest to the average histogram value of between frame m_1 and frame m_2 as key frame, jump to 16);
- B. If not established, continue to the next step;
- 11) Calculate the frame difference between frame k and the candidate key frame, denoted as $d_{k,p}$;
- 12) Determine whether the formula $d_{k,m_1} > T$ is established;
- A. If established, continue to the next step;
- B. If not established, return back to 9);
- 13) Set $k = k - 1$, calculate the frame difference between frame k and the candidate key frame p , denoted as $d_{k,p}$, and determine whether the formula $d_{k,m_1} > T$ is established;
- A. If established, return back to 13);
- B. If not established, execution 14);
- 14) determine whether the formula $k > m_2 - 1$ is established;
- A. If established, then set $m_2 = k$, calculate the average histogram from frame m_1 to frame m_2 , denoted as \bar{D} , and select the frame closest to the average histogram value of between frame m_1 and frame m_2 as key frame, execution 15);
- B. If not established, select m_1 as the key frame, continue to the next step;
- 15) Set $m_1 = m_2 + 1$, select frame m_1 as new key frame, jump to step 2);
- 16) End;

Test results and Conclusion

In experiment 1, this paper selects a video section with 7244 frames, and selects key frames from this video section, respectively by static frame average algorithm and dynamic frame average frame algorithm improved in this paper.

Because the transformation of lens is more, and the number of key frames is relatively more, only a part of the experimental results are given below, their contrast results are shown in figure 1

and 2 (label number is denoted as the camera number).



Figure 1. results of static frame average algorithm



Figure 2. Results of algorithm improved in this paper

In experiment 2, this paper selects the same video section, and selects key frames from this video section by dynamic frame average algorithm and improved algorithm in this paper (set the frame step $l = 4$). We take one sub shot as a research object, the frames chose are shown in figure 3 and the contrast results are shown in table 1.

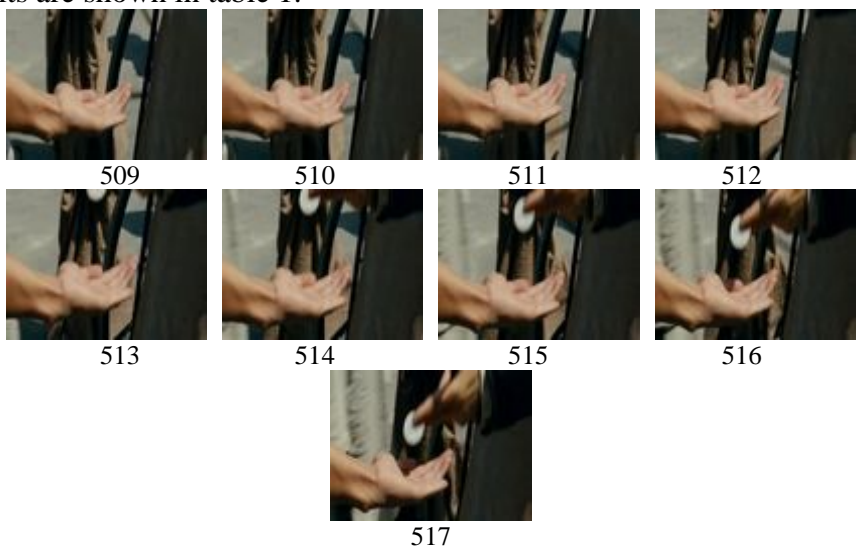


Figure 3. Frames of the sub shot

Table 1. Contrast results of the experiment

A	B	C	D	E	F
dynamic frame average algorithm	509	510、 511、 512、 513、 514、 515、 516	514	509、 510、 511、 512、 513、 514、 515、 516、 517	16
this paper	509	513、 517、 516、 515	514	509、 513、 517、 516	8

A- algorithm, B- key frame, C- Comparison order between frames and the key frame, D-new key frame, E- Comparison order between frames and the new key frame, F- number of comparisons.

The result of the experiment 2 can prove that the improved dynamic frame average algorithm reduces number of comparisons significantly when extracting key frames, improves the efficiency of extracting.

References

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