Assignment 5 - Video Textures

Andrew Parmar
CS6475 Fall 2022
aparmar32@gatech.edu

(a) computeSimilarityMetric (b) transitionDifference (c) findBiggestLoop score

Fig. 1: Sample Candle - Transition Matrices

(a) Candle start frame (b) Candle end frame

Fig. 2: Sample Candle - Start and End Frames

Alpha Value: 0.007
Link to Results: https://gatech.box.com/s/0pyy0excgxu1rgyqcd3isgflghua09hj

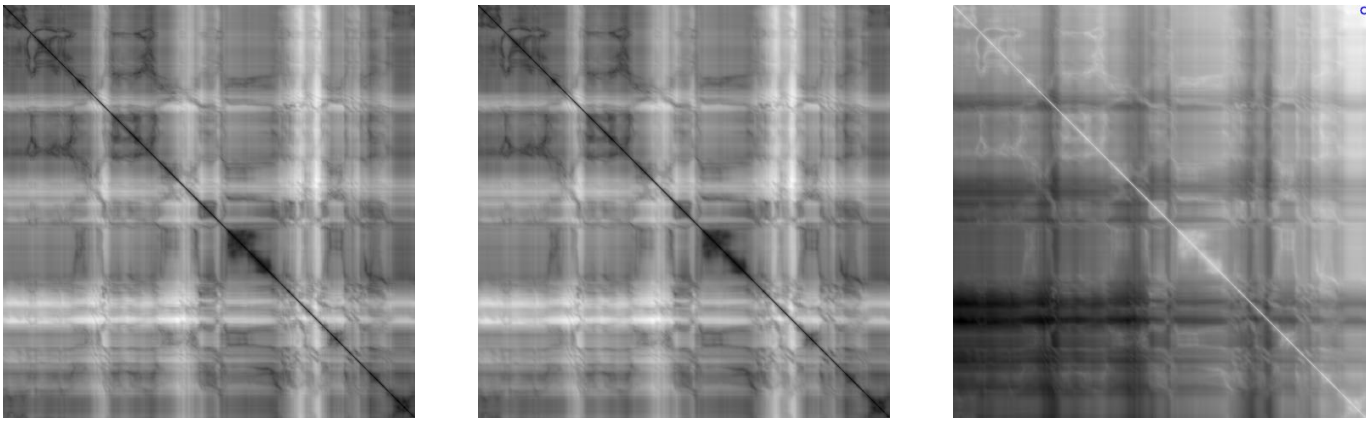

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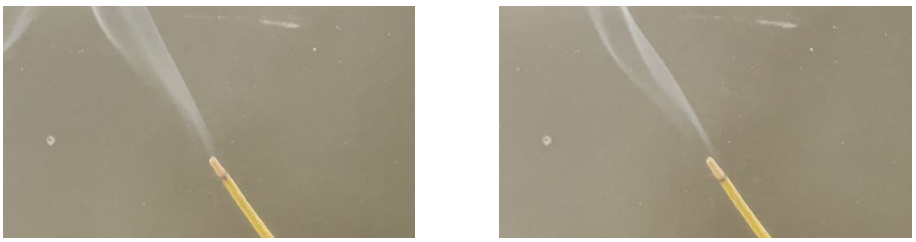
Fig. 3: Original Best Input - Transition Matrices



(a) Incense smoke start frame (b) Incense end frame

Fig. 4: Original Best Input - Start and End Frames

Description: Smoke from a burning incense stick on my desk.
Alpha Value: 0.001
Link to Results: https://gatech.box.com/s/0pyy0excgxu1rgyqcd3isgflghua09hj

I. Results Discussion - Sample and Original Inputs

1) **Did you get a good result from the sample candle inputs? If yes, what were you happy with? If no, what were you not happy with? Be specific.**
   Overall the result form the candle image set was decent. The transition is pretty seamless and when played in a gif can pass off as a long running video. The part that could have been better was the length of the loop. The loop is pretty short and is the only give away. If a longer sequence was detected it could have brought in more variety in the motion of the flame to give an even better effect.

2) **Did you get a good result from your own video? If yes, what were you happy with? If no, what were you not happy with? Be specific.**
   The length of the loop was really good. The final output used 97% of the frames from the video (start, and end indexes were 12 and 966 respectively, and total number of frames was 975). Because of the subject I chose, there was some lingering smoke in the air that made the transition in the last frame a slightly visible.

3) **How was the video you took different from working on the sample candle frames?**
   The main difference was the length of the video and subsequently the number of frames I was working with. The candle image set was 100 images of 90x90 pixels. In contrast the image set I was working with was of a video 30 seconds long at 30 fps, which came out to 975 frames. The full size images were 1920x1080 pixels which I resized a factor of 0.5 to give 960x540 pixel images. This larger set and images size made the algorithm runtime much longer. The candle set ran in 10 seconds, while the original set took 18 minutes.

4) **List at least 2 things that you found difficult while working on this assignment. For each, explain how you overcame the difficulty.**
   The majority of this assignment was tuning alpha values. While capturing videos, I took 7 different scenes out of which I had to ended up trying five to get a result that was I felt was acceptable. Most of the videos produced either a single frame start/end output or covered the whole set of images. Despite trying a large number of alpha values most of my did not videos produced good results.
   The second is a more logistical one. There were many different image sets to keep track of and various steps in the pipeline getting from video to images, and from images back to gifs. I was using a combination of bash and python scripts for all the conversion, resizing and gif creation so there was a certain aspect of bookkeeping that was needed which was a bit tedious.

5) **Discuss at least 2 things that you would do differently to create a better original result if you were to do this assignment again.**
   I feel the algorithm as it is right now can sometimes give results that are close, but have a single jerky motion that breaks the seamless nature of the loop. Even if this sudden chance is small, it is still perceptible. Incorporating a blending process between the start and end frames could greatly reduce this. As my original set was large, I reduced it by 50%. This still took pretty long to get through, and it wasn't until much later that I realized the same results were outputted even when using a 0.1 scale image set. This really improved development time. I would take this step earlier in the process. Lastly having a processing pipeline to reduce manual work would have been very useful. I would spend more time automating the end to end process, while using configuration parameters to controls how the pipeline worked. This would allow for more automated testing.

alpha	idx (start, end)	frame count	comments
0.5, 0.2, 0.9+	(2, 97)	96	abrupt switch
0.001, 0.005	(2,2)	1	just a single frame not useful
0.01, 0.02, 0.009	(39, 91)	52	smooth transition
0.007	(40, 91)	51	smoothest transition

TABLE I: Alpha value trials for Candle set

alpha	idx (start, end)	frame count	comments
0.5	(2, 971)	970	full set used, jerky transition
0.005	(9, 969)	961	transition is a bit jerky
0.001	(12, 966)	955	smooth transition
0.0005	(2, 2)	1	just a single frame not useful
0.0009	(12, 966)	955	smooth transition

TABLE II: Alpha value trials for Original set

II. Finding Alpha Discussion

1) **Describe how you determined the best alpha value for the sample candle and your original video textures. For EACH result, describe what alpha values you experimented with before deciding on the best alpha value. How was EACH result affected as alpha increased? Decreased?**
Table-1 describes the chronological order in which I tested alpha values for the candle set. Starting with the default value in the assignment notes I used 0.5 to see where the algorithm landed. The visual result was not very good which then led me to try 0.2 and 0.9 as a way of testing directionality. Both these showed the same result as the first trial. I then tried larger values of 10 and 20 as shown by 0.9+, and still got the same result. At this point I encountered an ed post talking more about alpha values. This led me to start trying smaller number like 0.001, and 0.005 which resulted in a change in the output but it was just a single frame. Using a binary search approach, I tried a magnitude in between the first two results, and got a reasonable result with 0.01. Tweaking a bit more I landed on 0.007 which reduced the frame count but had the smoothest visual result.

   Table-2 shows the order of trial for the original set. With the insights from the candle set, I applied a 0.5 alpha once again to get a starting point. This showed the full range of frames being used and so I decided to test lower to find the bottom. I applied 0.005 and got 961 frame. Going still lower, I got 955 frame. Going one order less dropped the frame count to 1, so I knew I had found my bottom limit. From here I experimented with values in the 0.00x range and landed on 0.001 as the best visual result.

2) **Was the best alpha for your original video the same as the one for the sample candle? If they were the same, why do you think this is? If they were different, why do you think this is?**
The alpha value controls the balance between the loop length and the transition difference between any two frames. My alpha values came out different because the motion in the two image sets were different. The candle image had more variability when the frame were far apart. Then incense video on the other hand had lots of variability in the middle, but the start and end showed good laminar flow in the smoke.

References

[1] Arno Schödl, Richard Szeliski, David H. Salesin, and Irfan Essa. 2000. Video textures. In Proceedings of the 27th annual conference on Computer graphics and interactive techniques (SIGGRAPH '00). ACM Press/Addison-Wesley Publishing Co., USA, 489–498.

[2] NumPy Docs, np.diag, np.diag, Accessed Oct 20, 2022

[3] Ed Post, James Michael Bertrand, Post, Accessed Oct 21, 2022