ISSN : 2229-4333(Print) | ISSN : 0976-8491(Online)

Feature based Image Morphing

[1]Bhumika G. Bhatt, [2]Hita M. Joshi
[1]VBTIT & RC, Bardoli, India
[2]Marwadi Engg. College, Rajkot, India

Abstract
Image Morphing is a powerful tool that can enhance many multimedia projects, presentations, education and computer based training. It is also used in medical imaging field to recover features not visible in images by establishing correspondence of features among successive pair of scanned images. This paper discuss what morphing is and implementation of Feature based Image Morphing. Also it analyze this method in terms of different attributes such as computational Time, Visual quality of morph obtained and complexity involved in selection of features.

Keywords
Morphing, Feature Morphing, Field Morphing, Interpolation.

I. Introduction

Morphing is derived from term Metamorphosis means changes in object form [7]. It is a digital image Processing Technique used as animation tool for metamorphosis from one image to another image [3]. Basically, morphing is achieved by coupling image warping with color interpolation [6].The idea is to specify a warp that distorts the first image into the second. Its inverse will distort the second image into the first. As the morphing proceeds, the source image is gradually distorted and is faded out, while the destination image starts out totally distorted toward the source image and is faded in. early images in sequence more like source image [1, 2]. The middle image of the sequence is the average of the source image distorted halfway toward the destination image and the destination image distorted halfway back toward the source image. The last images in the sequence are similar to the destination image. The middle image is key, if it looks good then probably the entire morphing sequence will look good [3]. Feature specification is the most tedious aspect of morphing. Given feature correspondence constraints between both images, a warp function over the whole image plane must be derived. This process is referred warp generation, and it is an interpolation problem. Warping determines the way in which the pixels in one image should be mapped to the pixels in the other image [5]. Another interesting issue in image morphing is transition control. If transition rates are allowed to vary locally across in between images, more interesting animations are possible [2].

In this paper we intend to analysis this morphing technique based on implementation results on various attributes. We have defined attributes such as Computational Time, Visual Quality of Morphs obtained and Complexity involved in Selection of features, for making an effective comparison.

The rest of the paper is divided as follows: Section II explains the principal behind morphing algorithms, Section III deals with various warping techniques with section A. follow with line warping with Feature based Morphing method. Section IV presents our implementation results with analysis study and Section V a brief conclusion.

II. Morphing Principal

The basic principle behind image morphing is explained in this section. Before the development of morphing, image transitions were generally achieved through the use of cross-dissolves, e.g., linear interpolation to fade from one image to another. Fig. I depicts this process applied over ten frames. The result is poor, owing to the double exposure effect apparent in misaligned regions. This problem is particularly apparent in the middle frame, where both input images contribute equally to the output. Morphing achieves a fluid transformation by incorporating warping to maintain geometric alignment throughout the cross-dissolve process [1, 2]. So Morphing refers to the combination of generalized image warping with a cross-dissolve between image elements. In order to morph between two images we define corresponding control pixels in source image I0 and destination image I1. We then define each intermediate frame I of the metamorphosis by creating a new set of control pixels by interpolating the control pixels from their positions in I0 to the positions in I1.Both images I0 and I1 are then warped toward the position of the control pixels in I. These two warped images are cross-dissolved throughout the metamorphosis [6]. Therefore the different morphing techniques differ mainly in the way in which they perform warping. In the following section we will describe various image warping techniques.

Fig.1 : Cross-dissolve Image

III.Warping Techniques

The process of warping an image can be divided into two steps: First, Compute the desired displacements of all pixels in the source image, and second, resample the image to create the output image. Resampling can be performed efficiently by processing horizontal and vertical displacements in two separate stages. For the first step it is necessary to construct of a suitable mapping function also called as the deformation step. It is commonly performed either by applying a global analytic mapping function to the image pixel positions or by using a set of control points that specify the displacements of some points in the initial image. In mesh morphing [1, 2] requires these control points to be the nodes of quadrilateral mesh. In Field morphing [3] uses control lines. Scattered data interpolation through triangulation of the data points is a classic approach to scientific visualization [4].

A. Feature Morphing

This method gives the animator a high level of control over the process. The animator interactively selects corresponding feature lines in the 2 images to be morphed. The algorithm uses lines to relate features in the source image to features in the destination image. It is based upon fields of influence surrounding the feature lines selected. It uses reverse mapping (i.e. it goes through the destination image pixel by pixel, and samples the correct pixel from the source image) for warping the image. A pair of lines (one defined relative to the source image, the other defined relative to the destination image) defines a mapping from one image to the other.

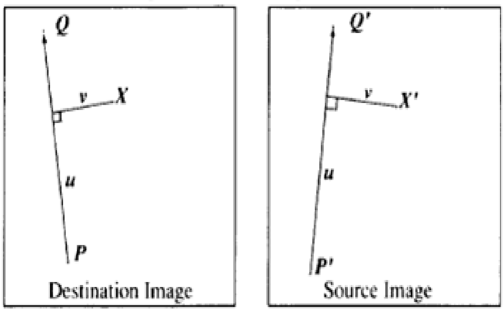


Fig. 2 : Single pair line algorithm [3]

The following parameters are calculated as,

$$u = \frac{(X-P).(Q-P)}{||Q-P||^2} \quad (1)$$

$$v = \frac{(X-P).Perpendicular(Q-P)}{||Q-P||} \quad (2)$$

$$X' = P' + u.(Q'-P') + \frac{v.Perpendicular(Q'-P')}{||Q'-P'||} \quad (3)$$

Where, X is the pixel co-ordinate in the destination image and X' is the corresponding pixel co-ordinate in the source image, PQ is a line segment in the destination image and P'Q' is the corresponding line segment in the source image, u is the position along the line, and v is the distance from the line. The value u goes from 0 to 1 as the pixel moves from P to Q, and is less than 0 or greater than 1 outside that range. The value for v is the perpendicular distance in pixels from the line. The above algorithm is for the case of a single feature line. In a normal morphing scenario, however there are multiple features in the images to be morphed and consequently multiple feature line pairs are specified.

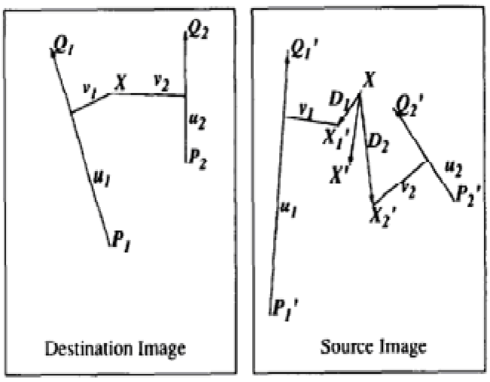


Fig. 3: Multiple pair line algorithm [3]

The displacement of a point in the source image is then, actually a weighted sum of the mappings due to each line pair, with the weights attributed to distance and line length. The weight assigned to each line should be strongest when the pixel is exactly on the line, and weaker the further the pixel is from it. The equation used is as follow.

$$\text{weight} = \left(\frac{\text{length}^p}{(a + \text{dist})}\right)^b \quad (4)$$

B. Feature Based Image Morphing Algorithm

Input: Source Image and Destination Image
Output: Morphed Image

Step 1: Select lines in source image (I0) and Destination Image (I1).
Step 2: Generate intermediate frame I by generating new set of line segments by interpolating lines from their positions in I0 to positions in I1.
Step 3: now intermediate frame I pixels in each line segments map to frame I0 pixels by multiple line algorithm.
Step 4: Multiple line algorithm
For each pixel X in the destination
DSUM = (0, 0)
Weight sum = 0
For each line Pi Qi
Calculate u, v based on Pi Qi
Calculate X'i based on u, v and Pi'Qi'
Calculate displacement Di = Xi' - Xi
dist = shortest distance from X to Pi Qi

$$\text{weight} = \left(\frac{\text{length}^p}{(a + \text{dist})}\right)^b$$

DSUM += Di * weight
Weight sum += weight
X' = X + DSUM / weight sum
Destination Image(X) = Source Image(X')
Step 5: then intermediate frame I pixels in each line segments map to frame I1 pixels by multiple line algorithm.
Step 6: now warped image I0 and warped image I1 is cross dissolved with given dissolution factor. Dissolution factor will be in [0 1].

Source Image

Destination Image (a) Simple Cross – Dissolve

Source Image

Destination Image (b) Feature based Morphing

Fig. 4 : Results of Morphing using (a) Simple Cross Dissolve (b) Feature based Morphing

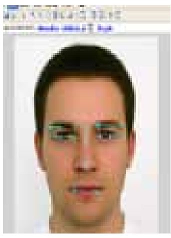
ISSN : 2229-4333(Print) | ISSN : 0976-8491(Online)

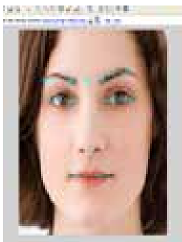
IV. Results

Fig. 4 illustrates the results of the morphing procedure using just cross dissolve and also with triangulation based Morphing algorithms and Feature based Image Morphing algorithm. It is evident from looking at fig. 4. that the morphs obtained by just cross dissolving the images without warping them is very bad. This is because features of the source and destination will not be aligned. Double Exposure is evident in the misaligned regions. From the results obtained we can also see that the quality of morph obtained using Feature based warping is more natural compare to simple cross dissolve. But computational complexity is high in this method. Also Feature morphing gives good results for different orientation images.

Feature morphing has disadvantage of "ghost" lines. It decrease morphing results. but it can be corrected by adding some lines or deleting some lines. Feature morphing gives high level of control to programmer on output results. Also computational complexity depends upon feature lines multiply by total number of pixels of image.

Also fig. 5. shows 6 feature lines selected by animator for feature based image morphing algorithm. Two eyes, nose line, mouth line and eyebrows lines.





Source Image Destination Image

Fig.5 : Feature Morphing with 6 Feature Lines

We feel that for a given quality of morph results the Feature based Morphing algorithm needs least effort on part of the animator. also with least specified feature lines good morphing results can be obtained. After implementing this method in MATLAB Finally we wish to put in a word on the individual advantage and disadvantages of this algorithm. Feature morphing requires less control lines by animator and gives natural morphing for different orientation images. But it has disadvantage of "ghost" lines which decrease morphing results. It can be recover by adding new lines or deleting some lines.

V. Conclusion

The focus of our paper has been to discuss image Morphing terms and survey various morphing algorithms and provide the analysis study of feature based image morphing algorithm implementation details with advantage and disadvantage. Feature morphing time complexity depends upon no. of feature lines multiplied by no. of total pixels of image. Also visual morphed results are natural for different orientation images in feature morphing and require to provide less control lines appropriately by animator. So for face images key features of face such as noise tip, eyes points and lip points can be extracted by preprocessing which make this morphing as automatic image morphing.

There are a variety of Image Morphing algorithms such as Thin Plate Spline Image Morphing, Image Morphing with snakes and free formed deformations, Image morphing using deformable surfaces and many others besides. Due to paucity of resources and time, we are unable to provide a comprehensive comparison of these algorithms.

References

[1] George Wolberg, "Recent Advances in Image Morphing", Department of Computer Science City College of New York.

[2] Wolberg, G. "Image Morphing: A Survey", Visual Computer (2008), vol. 10, pp. 3150-225.

[3] Beier, T., Neely, S., "Feature-based image metamorphosis", Proc. SIGRAPH 92 Computer Graphics (2002), pp. 35-102.

[4] D. Ruprecht, H. Muller, "Image warping with scattered data interpolation", IEEE Computer Graphics and Applications,15(2):23–103, March 2005.

[5] Pramod Potluri ,Krishna Sagiraju, Venkatachalam Tubati "Image Morphing: Feature based, View and Mesh", Clemson University, Clemson.

[6] Prashant K. Oswal, Prashanth Y. Govindaraju "Image Morphing: A Comparative Study", Department of Electrical and Computer Engineering, Clemson University, Clemson.

[7] Wolberg, G., "Digital Image Warping", IEEE Computer Society Press, Los Alamitos, CA, 2000.