Image Morphing Techniques: An Overview and Analysis

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ABSTRACT

Picture transformation, ordinarily known as transforming, is utilized to create a grouping of pictures that change a source picture into an objective picture. This method is regularly used to make enhancements for films or TV. Picture transformation is performed by coupling picture twisting with shading insertion. The thought is mutilating the primary picture into the second one and the other way around. This paper talks about an outline and difficulties of various transforming systems for controlling two-dimensional human facial pictures.

***Keywords**: Image Morphing.*

I. INTRODUCTION

Face transforming procedure is all around generally utilized in different fields like PC liveliness, recreations and motion pictures. The fundamental idea is to make a halfway picture by blending the pixel shade of the first picture with another picture. In this technique a source face picture is changed into a goal face picture easily by adding some in the middle of pictures; henceforth, the introduced pictures contain comparable highlights to both the source picture and the goal picture. For such insertion between two face pictures, the comparing pixels between the information pictures must be determined. When the two pictures have been twisted into arrangement for middle component positions, cross disintegrate produces in the middle of pictures. Here, twisting is the bending in a picture as indicated by a mapping between a source space (u, v) and an objective space(x, y) [1, 2]. Picture twisting is utilized in picture preparing fundamentally for redress of geometric twists. Cross-break up is a shading change (i.e., a gathering of changes of the picture shading space). All in all, picture transforming is the mix of picture distorting with a cross-break up between pictures. As the transforming continues, the main pictures of the succession look like the source picture, while the last pictures are like the objective picture. The center picture contains a normal of the source and the objective picture changed in accordance with normal component geometry.

II. PROBLEM DEFINITION

The component correspondence is utilized to process the mapping capacities that characterize the spatial connection between all focuses in the two pictures. Highlight particular is the dullest part of transforming. In spite of the fact that the decision of suitable natives may change, all transforming methodologies require cautious regard for the exact position of natives. Given element correspondence requirements between the two pictures, a twist work over the entire picture plane must be determined. This procedure, alluded to as twist age, is basically an introduction issue. Another intriguing issue with regards to picture transforming is progress control. In the event that progress rates are permitted to shift locally crosswise over center pictures, additionally fascinating movements are conceivable.

III. LITERATURE REVIEW

There are number of advantages in applying face morphing technique in various kinds of work. We can categorize them into five groups, based on their corresponding pixel mapping method.

3.1 Cross-Dissolving Method

The easiest way of morphing is cross dissolving, because this method uses the pixels located in the same position of the source image and the destination image to calculate the result. In this method there is overlapping of colors and positions in the result image transition. [4, 5, 6].

Fig 1: Cross Dissolve

3.2 Mesh Warping

This method uses a non-uniform mesh to define control points between the source image and the destination image. The mesh table of the source image is mapped to another mesh table on the destination image. The calculation is taken on each mesh, which should be easily computed. However, to use mesh warping methods, the source image and destination image should be rather similar in shape because a pixel will be mapped to another pixel with the positions on the mesh tables [3, 4, 6, 7, 8].

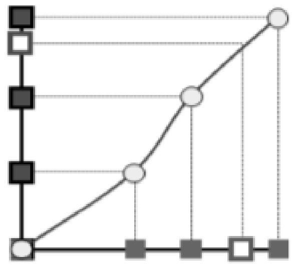

Fig 2: Wrapping a Scanline

3.3 Field Morphing Method

This is a method that uses lines to mark the main features of the face such as the eyes, nose, mouth and edges of the face. The computation uses the lines of the source image, which are mapped to the same type of line in the destination image. For example, the line that marks the nose in the source image should be mapped to the line that also marks the nose in the destination image as well. [6, 7, 8, 9, 10]

3.4 Point Distribution Method

This method uses points that the users fix to each main feature of the face, to help map the source image and the destination image together. The computation uses these points to calculate the result images. The resulting images from this work are satisfactory to the users. However, it is not automatic, because the users have to fix the mapping point of the features before making the program merge them together. [11, 6]

3.5 Critical Point Filters Method

The critical point filters method can extract the main features of the face by using the color difference in the features. The maximum sub-image can extract the eye and hair of the face, the max-min saddle subimage can extract lips, the min-max saddle sub-image can extract the skin and the minimum sub-image can extract the background of the image [6, 12, 13]

IV. Morphing Techniques

There are an assortment of transforming strategies in the writing [14]. Every one of these techniques has its own focal points and inconveniences. There are two methods that are generally used to twist pictures: work distorting field transforming and. field transforming will be quickly tended to in a later segment. 1. Triangle Mesh Warping: Triangle work distorting comprises of non-uniform matrices having an appropriate arrangement of triangles with the given information focuses being the sides of the triangles (called triangulation). The source picture is alluded to as IS and the objective picture is alluded to as IT. The source picture has a related work MS that indicates the directions of various highlights. A moment work, MT, indicates their relating positions in the objective picture. Facial highlights, for example, the eyes,nose, and lips should lie below corresponding grid lines in both meshes. Together, MS and MT are used to define the spatial transformation that maps all points in IS onto IT. In the meshes no folding or discontinuities are permitted (i.e., topologically equivalent). Therefore, the nodes in MT may wander as far from MS as necessary, as long as they do not cause self-intersection [10]. Catmull-Rom cubic spline is connected to the mesh points. Figure 2 shows warping a scan-line in 3x3 meshes. [8]

There is a mapping function between the scan-lines using the intersection points. Use Catmull-Rom cubic spline to interpolate and map each pixel on the scanline of the auxiliary image to the pixel on the scan-line in the original image. We need to find the coefficients of the Catmull-Rom cubic spline and substitute x to find the mapping.

Curve equation is :-

$Y (x) = ax3 + bx2 + cx + d$
$y''(x) = 3ax3 + 2bx2 + c$

From the properties of Catmull-Rom spline,
$Y (0) = d = y2$
$y'' (0) = c = (y3 – y1) / (x3 – x1)$
$r = x3 – x2$
$y (r) = ar3 + br2 + cr + d = y3$
$y''(r) = 3ar2 + 2br + c = (y4 – y2) / (x4 – x2)$
This method use two-pass algorithm means warping in horizontal direction followed by warping in vertical direction. It performs 2D image warping computation using a combination of two 1D warping computation.

4.1 Triangulation
A few distinctive triangulation procedures can be utilized for triangulation of a lot of focuses. Triangulation of a lot of focuses is a procedure that is done in PC illustrations [15]. Delaunay triangulation [16] is a well known technique for ideal triangulation of a lot of focuses. To compute the Delaunay triangulation, Voronoi locales [16] ought to be acquired. Various immediate and backhanded development techniques are accessible for the Delaunay triangulation. The strategy that is received in this work is the blend of the quality triangular work age proposed by Ruppert [17] and the partition and vanquish steady Delaunay triangulation proposed by Guibas and Stolfi [16]. These two triangulation procedures have been accounted for to produce more exact outcomes than the current partners and to be quicker than them. A triangle is coded by its location (position) in the diagram. Voronoi chart and Delaunay triangulation of an example face picture is appeared in Figure 3. A lot of 80 unmistakable focuses are utilized for calculation of the Delamay triangulation.

Figure 3: Triangulation of a face image using 80 distinct points. a) Voronoi diagram. b) Delaunay triangulation.

4.2 Field Morphing:
Another alternative morphing technique is to warp images with a field morphing Algorithm. Field morphing was introduced by Beier and Neely (1992) [9].
The user has to provide the algorithm with a set of control line segments. The segments serve to align the features of images A and B. The more control line segments there are, the more control the user has over these shape changes. For faces, for example, the line segments can be drawn over the contour line segments of the head, the ears, the eyes, the eyebrows, the lips, the nose, and so on.

Fig 4: Field Morphing

In Figure 4,127 sections are drawn over the forms and highlights of the face. In the twisting period of field transforming, correspondences are determined between the pixels of the pictures to be transformed. The calculation is called field transforming in light of the fact that each line fragment applies a field of effect on the arrangement to such an extent that pixels close to a portion in one picture will in general be lined up with pixels close to the comparing section in different pictures. Under a specific parameter setting, the calculation ensures that pixels on a fragment in one picture will be lined up with the pixels on the comparing section in different pictures. I will now initially clarify the field transforming strategy with only a solitary control line section and after that clarify the method with multiple control line segments.

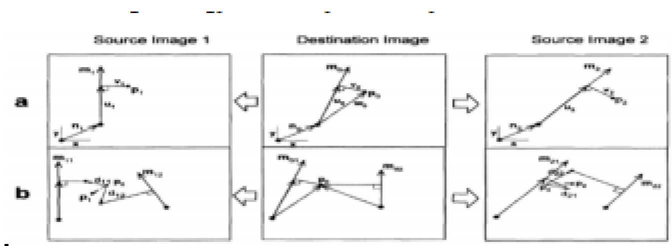

Fig.5 (a) Single Control Line Segment (b) Two control line segments

4.2.1 Single Control line Segment

Let us first discuss the case in which there is only a single control line segment in two images. Let i = 0 to refer to the destination image, and i = 1 and i = 2 refer to the two source images, respectively. The control line segments are defined in terms of a pair of vectors. n: length which goes from the origin of the coordinate system to the starting location of and the other representing its orientation) m: length which goes from the starting location to the ending location of segment li Now the first step in field morphing is to calculate the coordinates for the line segment in the destination image on the basis of the coordinates of the line segments from the source images. The following equations transform the segments l1 and l2 in the source images into the segment l0 in the destination image by transforming m1 and m2 into m0 and by transforming n1 and n2 into n0:

$m0 = m1 + \alpha (m2 – m1)$

$n0 = n1 + \alpha (n2 – n1)$

Where, α: relative influence of the segments of the first and the second image (varies between 0 and 1), although values outside this range will be used for generating caricatures.

4.2.2 Multiple control line segments:

Figure 5a shows twisting with two line sections. Each picture presently has two control line portions. For each position vector P0, figurings for each fragment in every one of the two source pictures lead to potentially unique position vectors. An extraordinary position vector Pi is determined for picture I by joining all individual position vectors in a weighted normal. Different names are overlooked for reasons of clearness. Beier and Neely's calculation

[9] loads the commitments of each fragment to acquire a solitary source facilitate pi. Weight of each line pair relies upon the length and separation. pij : source facilitate, where j records the control line fragment. dij: a removal vector, which is a dislodging from po to pij. The individual removals dij are summed in a weighted normal to acquire the single relocation toward pi. Each weight is an element of the separation from p0 to the section j and the length of fragment j. The weight capacities utilized are:

$$p_i = p_0 + \frac{\sum d_{ij} w_{ij}}{\sum w_{ij}}$$

$$w_{ij} = \left[\frac{\left\| m_{0j} \right\|^c}{\left(a + \left\| v_{ij} \right\| \right)} \right]^b$$

Where a, b and c are parameters. The second step is the computation of the twists of the two pictures toward the new line portions. There are two different ways of doing this: a forward mapping and a turn around mapping.[8]

4.2.3 The upside of the field transforming strategy over the work distorting technique:
In field transforming there is simplicity of adjusting the line fragment to highlights present in a picture. In the work twisting technique, when askew shapes are available in the picture, one can pick either an at first vertical or an at first level edge of the framework and adjust it to part of the corner to corner form. It tends to be hard to settle on these decisions when the picture contains shapes that change direction, (for example, the form of a face). It requires more investment to process a transform than with the work twisting strategy.

V. CONCLUSION

Transforming calculations regularly share a few parts, for example, highlight particular, twist age, and progress control. The simplicity with which specialists can viably utilize transforming devices is controlled by the way in which these segments are tended to. We quickly reviewed broadly utilized transforming methods, for example, work twisting and field transforming.

REFERENCES

1. *PS Heckbert, "Fundamental of texture mapping and image warping," M.S. thesis, Dept. of Electrical and Electronics Engineering, University of California, Berkeley, CA 94720,June 1989.*
2. *G Wolberg, Digital Image Warping, IEEE Computer Society Press, Los Alamitos, CA, 1990.*
3. *AZ Kouzani, S Nahavandi, N Kouzani, LX Kong, FH She. A morphing technique for facial image representation, IEEE Int. Conf. Syst., (2000) Man Cybern., (2), 1378–1383.*
4. *T Terada, T Fukui, T Igarashi, K Nakao, A Kashimoto, Y Wei Chen. Automatic Facial Image Manipulation system and Facial Texture Analysis. International Conference on Natural Computation - ICNC, pp. 8-12, 2009.*
5. *V Zanella, G Ramirez, H Vargas, LV Rasas. "Automatic Morphing of Face Images". International Conference on Adaptive and Natural Computing Algorithms - ICANNGA, pp. 600-608, 2009.*
6. *Areeyapinan, Jennisa, Pizzanu Kanongchaiyos. "Face morphing using critical point filters." Computer Science and Software Engineering (JCSSE), 2012 International Joint Conference on. IEEE, 2012.*
7. *U Bhushan, GP Saroha, D Tiwari, " An Implementation of Image Morphing Through Mesh Morphing Algorithm", International Journal of Advanced Research in Computer Science and Software Engineering, 2012, 2(7), pp. 74-76.*
8. *Islam, Md Baharul, Md Tukhrejul Inam, Balaji Kaliyaperumal. "Overview and Challenges of Different Image Morphing Algorithms." International Journal of Advanced Research in Computer Science and Electronics Engineering (IJARCSEE) 2.4 (2013): pp-410.*
9. *Beier T, Neely S (1992). Feature-based image metamorphosis. Computer Graphics, 26 (2), 35-42.*
10. *Karam, Hussien, A. Hassanien, M. Nakajima. "Featurebased image metamorphosis optimization algorithm." Virtual Systems and Multimedia, Proceedings Seventh International Conference on. IEEE, 2001.*
11. *Zanella, Vittorio, Olac Fuentes. "An approach to automatic morphing of face images in frontal view." MICAI 2004: Advances in Artificial Intelligence. Springer Berlin Heidelberg, 2004. 679-687.*
12. *B Chambers. "Point-And Window-Based Matching in Images Using Critical-Point Filters", Master,,s Thesis, Department of Electrical Engineering University of Illinoist at Urbana-Champaign, 2004.*
13. *K Thanasoontornlerk, P Kanongchaiyos, "An Image Matching Using Critical-Point Filters and Level Set Analysis", International Conferences in Central Europe on Computer Graphics, Visualization and Computer Vision, 2007.*
14. *George Wolberg, "Recent advances in image morphing," in Proc. Computer Graphics Intl., Pohang, Korea, June 1996, pp. 64-71.*
15. *JD Foley, AV Dam, SK Feiner, JF Hughes. Computer Graphics: Principles and practice. Addison-Wesley Professionals, 2 edition, 1996.*
16. *MJ Jones, T Poggio, "Model-based matching by linear combinations of prototypes," Tech. Rep.1583, MIT AI Lab., November 1996.*
17. *JR Ruppert. "A delaunay refinement algorithm for quality 2-dimensional mesh generation". Journal of Algorithms, 1995, 18(3), pp. 548-585.*