FACIAL IMAGE MORPHING FOR ANIMATION USING MESH WARPING AND CROSS DISSOLVING TECHNIQUE

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ABSTRACT

Image morphing has proven to be a powerful visual effects tool in film and television and in the fluid transformation of one image into another, too. Image Morphing comes from the word Metamorphosis which means change shape as well size of an image. Morphing means transition from one object to another. An animation technique metamorphoses the first image into the second. Image morphing process has two steps: first step is, image is gradually distorted and is faded out and the second step is, image starts out totally distorted toward the first and is faded in. The morph process consists of two steps: first is warping two images so that they have the same shape and second step is the cross dissolve the resulting images. A warping technique of interpolating which is used for other pixels.

Index Terms: Image partitioned, Image Morphing, Distorted, Faded, Mesh Warping, Cross dissolving.

1. INTRODUCTION

Morphing means an animated transformation of one image into another image. It has a special effect in motion pictures and animations that morphs one image into another through a seamless transition. Mostly it is used to depict one person turning into another through technological. Morphing involves image processing techniques they are image warping and cross dissolving. Cross dissolving is nothing but one image fades to another image using linear interpolation. As the features of both images are not aligned so this technique is visually poor and in misaligned regions, it will result in double exposure. In order to overcome this skewed problem, before cross dissolving we used warping to align the two images. By using Warping technique, we can determine correlation of the pixels between the two images. Warping will not work if we don’t map the important pixels, so it is necessary to map. Cross dissolving is easy to determine but the real problem of image morphing becomes the warping technique.

Morphing is in reality a cross dissolving which is applied to warped images. Warping techniques differ in the way the mapping of control pixels is particular and the technique of interpolating which is used for other pixels. Finding Morphing applications are very easy. For giving special affects in Hollywood Movies, Film makers use advance morphing techniques. Morphing techniques are used in Disney animations also for speeding production. To generate face morphing there are small number of applications, so interest in this domain is increased.

2. PROBLEM DEFINITION

In this paper we are developing an Image Morphing software application in MATLAB for morphing images. Morphing is the process by which one picture smoothly transmits into another. The intermediate images are calculated from the source and destination images using a mathematical formula. The software would be implemented using the Mesh Morphing Method.

3. METHODOLOGY

Algorithm consists of a Feature Finder and a Face Morpher. Morphing involves mesh warping and cross-dissolving process. Mesh warping creates meshes in images and changes its shape according to target or source image. The following Figure 1 illustrates procedure.

Figure 1: Block Diagram of System
3.1 Pre-processing

In this paper we are developing an Image Morphing software application in MATLAB for morphing images. Morphing is the process by which one picture smoothly transmits into another. The intermediate images are calculated from the source and destination images using a mathematical formula. The software would be implemented using the Mesh Morphing Method when getting an image containing human faces, it is always better to do some pre-processing such like removing the noisy backgrounds, clipping to get a suitable facial image, and scaling the image to a reasonable size.

3.2 Feature Finding

To detect feature points we use Viola-Jones Algorithm Matlab. It detects people’s faces, noses, eyes, mouth, or upper body. The competitive object detection rates in real-time were provided by Viola-Jones object detection framework proposed in 2001 by Paul Viola and Michael Jones. Although this framework can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. The feature provided by the detection framework involves the sums of image pixels within rectangular areas. As such, these features have some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection. However, since the features used by Viola-Jones framework all rely on more than one rectangular area, they are generally more complex. The Figure 2 illustrates the four different types of features used in the framework. The value of any given feature is always simply the sum of the pixels within clear rectangles subtracted from the sum of the pixels within shaded rectangles. As is to be expected, rectangular features of this sort are rather primary when compared to alternatives such as steerable filters. Although they are sensitive to vertical and horizontal features, their feedback is considerably rough. However, rectangular features can be evaluated in constant time, with the use of an image representation called the integral image, which gives them a considerable speed advantage over their more sophisticated relatives. Because each rectangular area in a feature is always adjacent to at least one other rectangle, it follows that any two-rectangle feature can be computed in six array references, any three-rectangle feature in eight, and any four-rectangle feature in just nine.

3.3 Image Partitioning

Our feature finder can give us the positions of the eyes, nose and mouth. Based on this, 4 control points are found, these are centroid of both eyes, centroid of mouth and edges of both eyes. Beside these facial features, the edges of the face also need to be carefully considered in the morphing algorithm. If the face edges do not match well in the morphing process, the morphed image will look strange on the face edges. We generate 5 more feature points around the face edge, which are 4 corners of face edge and 1 is centroid of forehead. Hence, totally we have 9 control points for each face as shown in Figure 3.

![Figure 3: Control point detection](image)

Based on these 9 feature points, our face-morpher partitions each photo into 16 non-overlapping quadrangular regions as shown in Figure 4. Ideally, if we could detect more feature points automatically, we would be able to partition the image into finer meshes, and the morphing result would have been even better.

![Figure 4: Partitioned Image](image)
Since the feature points of images are generally speaking, at different positions, when doing morphing between images, the images have to be warped such that their feature points are matched. Otherwise, the morphed image will have four eyes, two mouths, and so forth. It will be very strange and unpleasant that way. In the warping process, coordinate transformations are performed for each of the 16 regions respectively.

### 3.4 Mesh Warping

The mesh-warping algorithm relates features with non-uniform mesh in the source and destination images, i.e., the images are broken up into small regions that are mapped onto each other for the morph.

We refer to the source and the target images as IS and IT, respectively. The source image is associated with mesh MS. It specifies the coordinates of control points, or landmarks. A second mesh MT specifies their corresponding positions in the target image.

![Figure 5: Mesh Warping](image)

Meshes MS and MT are respectively shown overlaid on IS and IT in the upper left and lower right images of the Figure. Notice that landmarks such as the eyes, nose, and lips lie below the 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. The meshes are constrained to be topologically equivalent, i.e., no folding or discontinuities are permitted. Furthermore, for simplicity, the meshes are constrained to have frozen borders.

### 3.5 Cross Dissolving

The Cross-dissolve is a useful color transformation. Given two images of f(z,y) and g(z,y), a cross-dissolve between them is a group of transformations of the image color space.

After coordinate transformations for each of the two facial images are performed, the feature points of these images are matched. i.e., the left eye in one image will be at the same position as the left eye in the other image. To complete face morphing, we need to do cross-dissolving as the coordinate transforms are taking place. Cross dissolving is described by the following Equation.

\[
C(x, y) = \alpha A (x, y) + (1-\alpha) B (x, y)
\]

For \(0 \leq \alpha \leq 1\)

Where A, B are the pair of images, and C is the morphing result. This operation is performed pixel by pixel, and each of the color components RGB is dealt with individually.

Quantitative Measure to study the effect of morphing is Computing Total Energy of Face Component. To compute the total energy of each face component, the first step is to compute energy related to the color intensity, Energy related to the edges, and energy related to the locations. Then, we will combine those three energy values to obtain the total energy.

1) Energy Related to Color Intensity (C)
2) Energy Related to the Edges (E)
3) Energy Related to the Locations (D)
4) Total Energy of the Mapping

### 4. RESULT AND DISCUSSION

Experimental Results are obtained successfully by implementing algorithm of mesh warping. Figure 6 shows original digital image that is source image which we have to morph according to target image, before morph it is need to pre-processing such as removing noise, clipping to get a proper facial image, and scaling the image to a reasonable size.

![Figure 6: Result of pre-processing: (a) Original Image (b) Pre-processed image](image)

Figure 7 shows feature finder results obtained by using Viola-Jones algorithm Matlab. Using it, we detect people faces, noses, eyes, mouth, or upper body. It forms 5 bounded boxes for eyes, nose, mouth and face.

![Figure 7: Feature Finder](image)

Figure 8 shows result of Image partitioned obtained by detecting 9 control points from feature finder and
partitioned image into 16 non-overlapping quadrangle region.

![Image Partitioning](image1.png)

(a) (b)

Figure 8: Result of Image Partitioning. (a) Detected control Points (b) Partitioned Image

Similarly we have to do all operation on target image. After partitioning of source and target image, we have to warp images using Mesh warping and we get intermediate images. Warped images are cross dissolved as per following output. Figure 9 shows all result images in output window of MATLAB software.

![Output window of Image Morphing of human faces](image2.png)

Figure 9: Output window of Image Morphing of human faces

Figure 10 shows sequence of output images. First row contains source image warped according to target image from left to right. Second row contains target image warped according to source image from right to left. And third row contains mixing of first and second row images.

![Cross-Dissolving output sequence of 2 intermediate images](image3.png)

Figure 10: Cross-Dissolving output sequence of 2 intermediate images

Figure 11 shows cross dissolving output sequence. It gives color transformation. First row contains source image morphed according to target image from left to right. Second row contains target image morphed according to source image from right to left.

![Cross-Dissolving output sequence of 14 intermediate images](image4.png)

Figure 11: Cross-Dissolving output sequence of 14 intermediate images

Similarly, we can perform morphing operation for animal faces too. And we get morphed output as following Figure 12, 13, 14.

![Output window of Image Morphing of animal and human faces](image5.png)

Figure 12: Output window of Image Morphing of animal and human faces

![Cross-Dissolving output sequence of 2 intermediate images (animal and human)](image6.png)

Figure 13: Cross-Dissolving output sequence of 2 intermediate images (animal and human)
Figure 14: Cross-Dissolving output sequence of 14 intermediate images (animal and human)

5. CONCLUSION

From this paper we can conclude that image morphing is successfully implemented using mesh warping algorithm combined with the cross dissolving technique. A few easily attributes, such as visual quality of morph, the ease with which the animator can select features such as eyes, nose and mouth with the help of our implemented paper. The algorithms we used were fast and instinctive, which accurately computed the mapping of each pixel from the source image to the destination image which was supposed to be our output. The mesh was formed of quadrangles obtained from the specified 9 control points. We have noticed in it that more the number of frames better were the morphed results. We found that, to get best results Mesh Morphing is an effective technique.

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