An Implementation of Enhanced Image Morphing Algorithm using Hybrid Approach

Jignasha B. Panchal
Computer Science & Engineering
Shri S'ad Vidya Mandal Institute of Technology,
Bharuch, Gujarat, India

Krupali R.Shah
Computer Science & Engineering
Shri S'ad Vidya Mandal Institute of Technology,
Bharuch, Gujarat, India

Nidhi J. Sanghani
Computer Science & Engineering
Shri S'ad Vidya Mandal Institute ofTechnology,
Bharuch, Gujarat, India

Rutvij H. Jhaveri
Computer Science & Engineering/IT
Shri S'ad Vidya Mandal Institute ofTechnology,
Bharuch, Gujarat, India

ABSTRACT
Image Morphing belongs to image processing defined as the animated transformation of one image into another, deliberately creates special effects, an essential in many multimedia systems and medical imaging field applications. In this paper, a digital image morphing technique is proposed with four phases. The initial phase of the stated algorithm takes source and destination image as an input from the specified location or through the webcam. The second phase deals with finding pixels by grid view of images for tracking the features such as eyes, mouth, nose, lips, ears and face. The third phase deals with mapping pixels from source image to destination image and then generate intermediate image with color interpolation and image transition. The forth most important phase of the process is generation of the final morphed resultant image in the number of certain required phases. This whole process, commonly known as morphing, is realized by combination of image warping with color interpolation or cross-dissolving. The results show that the proposed approach is simple and takes less time to generate the morph.

Keywords
Image Morphing, Cross-dissolving, Warping, Feature based Morphing, Mesh warping, Field Morphing, Metamorphosis.

1. INTRODUCTION
Morphing is derived from the word metamorphosis means change image into another image. Image Morphing is a digital image processing technique. Morphing is mostly used as animation tool for image processing techniques [1]. It is a special technique that creates a smooth transformation of one graphical object into another object and it creates animation over some period of time [2]. Image metamorphosis has proven to be a powerful visual effects tool [3, 4]. There are now many breathtaking examples in film and television depicting the fluid transformation of one digital image into another [4, 5]. It combines image warping and cross-dissolving [6]. Morphing process generates intermediate image by using color interpolation between source and destination image [6]. In cross-dissolving, double-exposure effect will be apparent in misaligned region of two images. This problem is overcome by warping techniques [7, 8]. Warping determines the way in which pixel in source image is mapped onto pixel in the destination image and some important pixels need to be specified in two images [7, 8]. The motion for other pixels is obtained by extrapolating the information specified for the control pixels [9]. Since cross dissolving is very simple, warping becomes the major problem of morphing techniques [9]. Optimal mass transport, which is mass moving energy functional, is modified by adding an intensity penalizing term, in order to reduce the undesired double exposure effect. It is an intensity-based approach and, thus, is parameter free [10].

Morphing is simply a cross-dissolve applied to warped image [9]. Image morphing process is based on single line and multiple line algorithms [6]. Morphing of images has evolved and become a challenging field in information hiding and data security [2]. The morphing effect is widely used for various tasks ranging from generation of fancy special effects, smoothing transition between video frames to funny warping of faces and mixing parent's photos for prediction of how their child will look like [11]. Morphing is used in medical imaging field to recover feature not visible in image by establishing corresponding of features among successive pair of scanned images. Morphing is widely used in movie animations, gaming industry, education and computer based training, multimedia projects. Film makers from Hollywood use advanced morphing techniques to generate special effects [12]. Even Disney animations are made using morphing, for speeding production. As there are few efficient techniques available to generate face morphing, there is an increased research interest in this domain [12].

In this paper, the stated digital image morphing algorithm furnishes a powerful tool for image morph, which is an effective combination of Feature based morphing [1], Mesh morphing [2] and Field Morphing [13]. Feature based image morphing selects a few feature lines from source image and destination image by animator [1]. It gives good effect but has speed issues and selects less number of feature line compared to mesh morphing algorithm [1]. Mesh morphing algorithm breaks image into small region and relates to non-uniform feature line for mapping pixel by pixel from source to destination image [2]. Mesh morphing does not produce better transition of image than feature based morphing; moreover, it takes more time during morphing process [2]. Field morphing follows similar conecpt as feature based morphing and selects feature lines but it takes time for produce good result [13]. This paper proposes an algorithm using different attribute transition, visual effect morphing and feature selection. It is based on number of required frames to produce better result. It overcomes limitations of feature selection in Field morphing, Mesh Warping and Feature based morphing by

using gridline in image. The proposed algorithm also overcomes the drawback of less execution speed during the morphing process.

In this paper, a new system for morphing software is implemented. The proposed algorithm builds new system for multimedia project and animation industries because of large scope and uses. An alternative approach for Image Morphing is presented that applies efficient Digital Image Morphing algorithm to get better resultant morphed output. The proposed algorithm would be of great use to people who carry out research in the area of image morphing.

The rest of the paper is divided as follows: Section 2 discusses related work on different image morphing related algorithms. Section 3 presents proposed work on image morphing process, Section 4 deals with implementation results of digital image morphing process. Section 5 concludes the paper.

2. RELATED WORK

Bhumika et al. [1] propose an algorithm that is 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. Feature morphing gives high level of control to programmer on output results. Computational complexity depends upon feature lines multiplied by total number of pixels of image. Feature morphing has disadvantage of *ghost* lines. It decreases morphing results which can be corrected by adding or deleting some lines.

Prashant et al. [9] analyze the mesh warping, thin plate spline and feature based morphing algorithm. In a thin plate spline (TPS) and feature based, the prime drawback is decrease in speed due to the amount time for each pixel map to another pixel in the image. Mesh Based Image Morphing algorithm has a considerable overhead involved in specifying features. The task of selecting the mesh nodes is very demanding and time consuming but it is more efficient than TPS and feature based.

Robert et al. [14] uses the mesh-warping algorithm that 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. The algorithm accepts a source image, a destination image and two 2D arrays of coordinates. The authors use the field morphing algorithm using lines to relate features in the source image to features in the destination image. It is based upon fields of influence surrounding two-dimensional control primitives. It applies the reverse mapping as its ways of warping. In this method, points left unmodified or points for which the animator could not find an associating feature are still used by the warping algorithm; the algorithm has speed and control problem.

Martin Bichsel et al. [15] have to find 4 major feature points, namely the two eyes, and the two end-points of the mouth. Within the scope of this project, the authors develop an eye-finding algorithm that successfully detects eyes at 84% rate. Based on eye-finding result, the authors then find the mouth and hence the end-points of it by heuristic approach. The process is performed with following phases: Image Partitioning, Coordinate Transformation (Mesh warping), and Cross-Dissolving. The proposed algorithm for Image Morphing provides very accurate result, but has higher time complexity.

Table 1. Comparison of existing image morphing techniques

Author	Technique Used	Advantage	Disadvantage
Bhunika et al. [1]	Featured based Image Morphing	Feature Morphing gives high level of control to programmer on output results and produce good animator effect.	Feature Morphing has disadvantage of ghost lines and speed.
Urvashi et al. [2]	Mesh Warping	Mesh Warping breaks images into small region and maps pixel to pixel from source to destination image. So no ghost lines appear in image.	It does not produce transition on image with more perfection and take more time at least two minutes in morphing process.

3. PROPOSED WORK

In this section, implementation of digital image morphing algorithm is presented based on the feature based image morphing and Mesh Warping algorithms.

Algorithm:

Step 1: Load and store source and destination images.

Step 2: Specify control line on both images and select line from source image and destination image.

Step 3: Find points in source image and the corresponding point of it lies within destination image. They are generated by following formula:

point[row, col] = new PointF((float)(p),(float)(q))

Where,

x = 1.0f - fraction;

p = m_Point[0, row, col].X * (x) + m_Point[1, row, col].X * fraction;

q = m_Point[0, row, col].Y * (x) + m_Point[1, row, col].Y * fraction;

Step 4: Find RED, GREEN and BLUE colour intensity of points, which lies from source to destination. They are generated by following formula:

//Calculate the red value

```
v11 = m_Bm[1].GetPixel(ix_in, iy_in).R;
v12 = m_Bm[1].GetPixel(ix_in, iy_in + 1).R;
v21 = m_Bm[1].GetPixel(ix_in + 1, iy_in).R;
v22 = m_Bm[1].GetPixel(ix_in + 1, iy_in + 1).R;

r1 = v11 * dx2 * dy2 + v12 * dx2 * dy1 + v21 * dx1 * dy2
+v22 * dx1 * dy1;
```

// Calculate the green value.

```
v11 = m_Bm[1].GetPixel(ix_in, iy_in).G;
v12 = m_Bm[1].GetPixel(ix_in, iy_in + 1).G;
v21 = m_Bm[1].GetPixel(ix_in + 1, iy_in).G;
v22 = m_Bm[1].GetPixel(ix_in + 1, iy_in + 1).G;
g1 = v11 * dx2 * dy2 + v12 * dx2 * dy1 + v21 * dx1 *
dy2 + v22 * dx1 * dy1;
```

// Calculate the blue value.

```
v11 = m_Bm[1].GetPixel(ix_in, iy_in).B;
v12 = m_Bm[1].GetPixel(ix_in, iy_in + 1).B;
v21 = m_Bm[1].GetPixel(ix_in + 1, iy_in).B;
v22 = m_Bm[1].GetPixel(ix_in + 1, iy_in + 1).B;

b1 = v11 * dx2 * dy2 + v12 * dx2 * dy1 + v21 * dx1 * dy2 +
v22 * dx1 * dy1
```

Step 5: Combine value of two colours from the intermediate frames generated images, where 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 away. They are generated by following formula:

```
SetPixel(ix_out, iy_out, Color.FromArgb(255, (int)( r ), (int)(
g ), (int)( b )))
```

Where,

```
x = 1.0f – fraction;
r = r0 * (x) + r1 * fraction;
g = g0 * (x) + g1 * fraction;
b = b0 * (x) + b1 * fraction;
```

Step 6: Getting the number of frames. More the number of frames, clearer will be the sequence of the morphed images. The number of frames will be entered by the user.

Step 7: Generate and display the resultant morphed image.

This paper represents digital image morphing on different images based on feature-based and mesh morphing approach. The application is implemented using C#.NET. The images are first loaded and stored in binary format in the database with the corresponding properties. Storing the image in binary format adds security and the decreases space complexity. After storing both images in database, both images are converted into grayscale for accurate morphed image result.

After completion of grayscale, sobel edge detection is applied on the processed image that is used for extracting eyes, curves, face and many such features. On both of the resultant images the next phase is to apply gridlines for extracting all features from source image to destination image by block matching.

A function is applied on images containing gridlines which matches corresponding blocks and finds pixel position block by block within two processed images. On every matched pixel apply delta rule.

a=-Ax*Ey+Ay*Ex

b=Ey*Dx-Dy*Ex+Ay*Cx-Ax*Cy

c=Dx*Cy-Dy*Cx

Check Condition:

if $\Delta >= 0$ then $a < 0.001$

t=-c/b

else

$(-b-\sqrt{\Delta})/2a$

Above formula searches point within the image found. After this process, implementation is carried out from start to end point which calculates RGB value for bitmap image and combines value of two colors of source and destination image. This whole process on images is carried out and it generates the frames with cross-dissolving and warping technique. When numbers of frames are more, it takes much time and also affects on the result. It produces better result with the limited number of frames in less time. In image morphing process it reduces the ghost lines in the morphed resultant image.

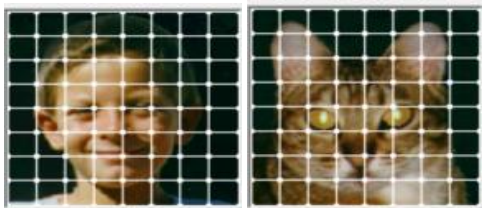
4. TEST RESULTS

Step1: Load Source Image and Destination Image

(a) **(b)**

Fig1: Source Image and Destination Image

Step 2 & 3: Grid view of image of both images for specifying and selecting control line and pixel from images which lies from source image to destination image.



(a) **(b)**

Fig 2: Grid line in Source Image and Destination Image

Step 4 & 5: Find corresponding point RGB colour intensity which lies within each other for generation of intermediate frames.

Fig 3: Intermediate frame from Source and Destination Image

Step 6: Getting number of frames.

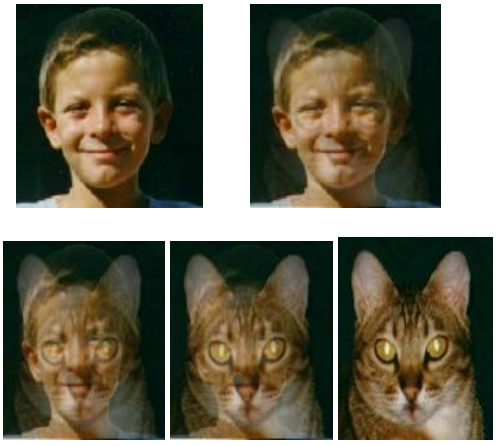
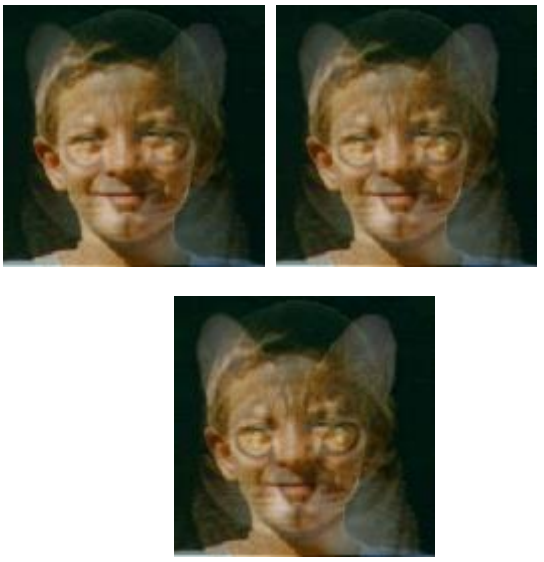


Fig 4: Generation of frame correspond to source & destination image

Step 7: Generate and display Morphed image during conversion of source image to destination image.



(a) Source Image

(b) Destination Image

Fig 5: Image Morphing Process

5. CONCLUSION

This paper successfully implements image morphing using Feature-based algorithm and Mesh Warping algorithm combined with Cross Dissolving technique. The algorithm is efficient, very smooth and intuitive, which generates effective morphed result by finding control grids and mapping the corresponding pixels from source image to destination image. Mesh warping gives the best result but it requires a significant amount of animator effort in selecting control pixels. The stated algorithm overcomes this drawback when combined with the Feature-based algorithm. It is noticed that the algorithm gives better morphed result in terms of number of frames corresponding to image sizes. It uses redness; greenness and blueness function and illustrates how the user would be able to find the intensity of image based on these functions. This paper demonstrates that an image containing two faces can be generated by morphing, and the cross-dissolving of faces generates indeed resemble of the two faces of source and destination image. Moreover, it demonstrates that image morphing algorithms can help generate animation type morphing.

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