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AN OVERVIEW ON IMAGE MORPHING AND ITS TECHNIQUES

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Abstract —*An image is an artifact that depicts or records visual perception and morphing means that transition from one form to another. So, if we combine this two words then we get the term IMAGE MORPHING. Image morphing is the process in which transition of one image to another image takes place. This effect is firstly used in the movie "The Golden Magic" and then this technique came into the world to create effects in movies. Here in this paper we are going to concentrate on terms image morphing, mesh warping (a methodology of image morphing). As well as we have defined the term metamorphosis through which "image morphology" word has been derived. Along with it we have discussed different methodologies of image morphing and in depth we have concentrated on mesh warping.*

Keywords- Metamorphosis, Image, Morphing, Warping, Cross Dissolve, Mapping

I.   INTRODUCTION

Metamorphosis is the biological process in which one form is changed to another form. For eg: a caterpillar forms a larva then converts into the pupa and then it forms into a butterfly. These transition in biological life is termed as metamorphosis. So, the term Morphing is derived from metamorphosis.

Fig.1Butterfly Transformation

Image morphing means seamless transition of one image into another image with use of the techniques. These morphing techniques are now done by using software based on the algorithms which will be discussed here.
Long ago, image morphing was implemented in the 1986 movie "The Golden Child" which implemented very crude morphing effects from animal to human and back, the first movie to employ detailed morphing was "Willow", in 1988.

II.   IMAGE MORPHING

Image morphing is referred as the animated transformation of one digital image into another. It is a powerful tool that has widespread use for achieving special visual effect in the entertainment industry. Morphing is achieved by coupling image warping with color interpolation. It was implemented in song by Mickle Jackson name "White and Black" [2].Also in some of the movies image morphing technique is being used such as: Twilight, Transformer, Lion King, and many other animated movies.
Morphing is combination of warping (shape geometric) and cross dissolve (color photometric)

III.   CROSS DISSOLVE

The simplest method of transforming one image into another is to cross-dissolve. In this method, the color of each pixel is interpolated over time from the first image value to the corresponding second image value.
This is not so effective in suggesting the actual metamorphosis. For morphs between faces, the metamorphosis does not look good if the two faces do not have the same shape approximately. [2]had implemented a morphing scheme which would combine cross-dissolve with warping methods to give good morphs.
The implementation of cross dissolve is as follows:

Fig 2 Cross Dissolve [2]

IV.   WARPING

Image warping is the process of digitally manipulating an image such that any shapes portrayed in the image have been significantly distorted. Warping may be used for correcting image distortion as well as for creative purposes. Pure warping means that points are mapped to points without changing the colors. For example we can say is satellite mapping system which monitors planet surface by taking thousands of images.

Let us consider that you are using a telescope to photograph a region of planet. After a few hours the planet will have rotated on its axis. The previous photograph region appears highly distorted both image contain complete information about the region just from different perspective.

The warp is specified by a mapping between lines in the first and second images. Warping is the combination of feature specification and warp generation. Feature specification is very much convenient while warp generation is very formidable or powerful technique.

There are two types of warping method which are as follows:
1.   Forward Mapping
2.   Reverse Mapping

3.1. Forward Mapping:-

Each pixel in the source image is mapped to an appropriate place in the destination image. We need interpolation to determine the pixel values. Thus, some pixels in the destination image may not be mapped[4].

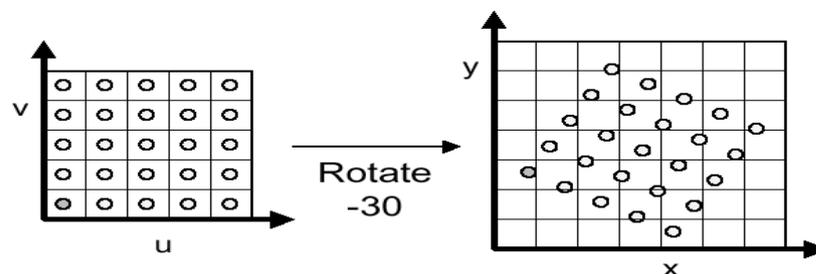This mapping was used in point-morphing algorithm.

Fig. 3 Forward Mapping [1]

3.2. Reverse Mapping:-

This method goes through each pixel in the destination image and samples an appropriate source image pixel. Here the source is found from image. Thus, all destination image pixels are mapped to some source image pixel.

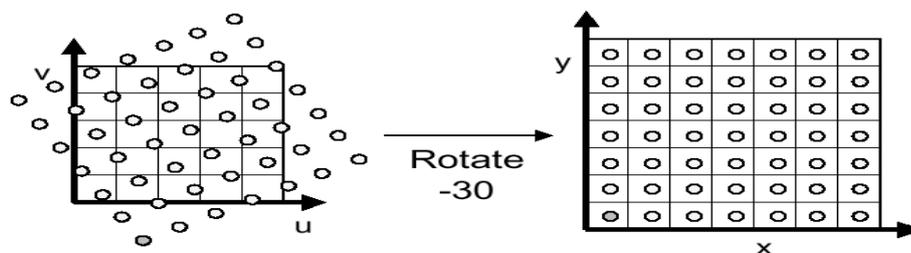This mapping has been used in the Beier/Neely line-morphing method[4].

Fig 4 *Reverse Mapping*[1]

There are three types of warping methods:
1.   Mesh Image Warping
2.   Feature-based Image Warping

3.   Thin plate spline Image Warping   [1]

V.   MORPHING TECHNIQUES

There many methodologies whose algorithm is used to morph the images which are mentioned as follows:

1.   Mesh Warping
2.   Field Morphing
3.   Radial bases Function
4.   Energy Minimization
5.   Multilevel Free Form Deformation
6.   Work Minimization

5.1. MESH WARPING

The mesh warping algorithm relates features with non-uniform mesh in the source and destination image.
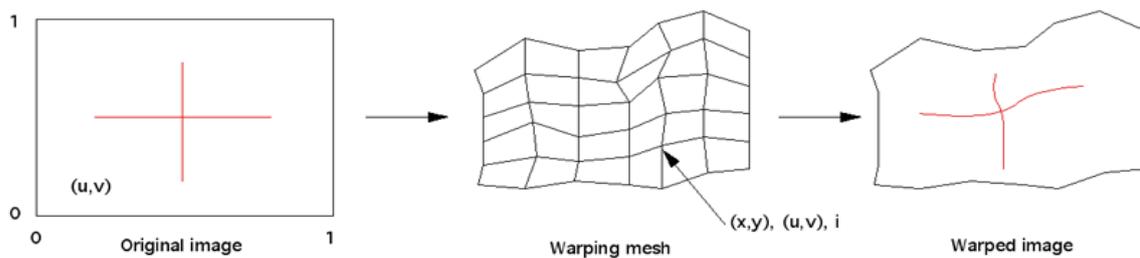

Fig 5 Image Warping

Non uniform mesh means that while forming the mesh images of source to destination there are no any uniform control points. It is much clearer through following image created by [2].

Fig 6: Non-uniform Metamorphosis[2]   **Fig 7: Uniform Metamorphosis[2]**

The warping can be performed in either the x, y coordinates or in the u, v coordinates or in both.

Here, in mesh warping [1] consider Is-source image and It-target image. Also Ms and Md as the source mesh and destination mesh respectively.

These all can be said as the control points.

5.1.1. Algorithm for Mesh Warping:-

Mesh algorithm was implemented by [2] as follows:

Step 1- Loading of Two Images

1. getImage (),
2. createImage (),
3. PixelGrabber class including functions getPixel () and grabPixel (),
4. drawImage ().

Step 2- Getting Corresponding Points ControlPoint c=new ControlPoint(X1, Y1, X2, Y2)

Step 3- Creating The Mesh Triangles are formed by the morph () function as an intermediate step. The Triangle is formed by the object of Triangle class which takes a parameterized constructor as the values of the objects of ControlPoint class. The particular triangles are then split into 22 SimpleTriangle such that they have same y coordinates.

Step 4- Can get number of frames by clicking the particular Menu Item through which we can see the video of morphed images which are arranged in a sequence and can have visual effect. User can enter the number of frames in a dialog box when asked for same.

Step 5- Intermediate points are the points which are formed by mapping the corresponding points of Imagesrc and Imagedest.

Step 6- Generation of the Morphed Images:- This function is implemented by the morphtriangle1 () and morphtriangle2 () function, which basically interpolate the pixel values at both the images and assign the value to the intermediate image.

Step 7- Displaying The Morphed Image This images generated in the previous step would be displayed in the sequence with the drawImage() function.

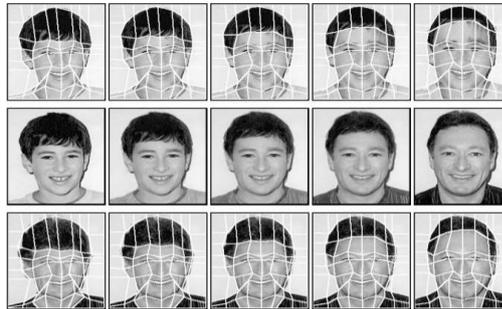The implementation of the mesh warping is as follows:

Fig 8 Implementation of Mesh Warping [2]

5.1.2. Advantages of Mesh Warping:
- Fast and intuitive
- Efficient algorithms exist for computing the mapping of each pixel from the grid.

5.1.3 Disadvantages of Mesh Warping:
- The animator must specify in advance how many control points to use to control image.
- Point for which the animator could not find and associating feature are still use try warping algorithms

5.2. Field Morphing
This global algorithm is slower than mesh warping, which uses bicubic interpolation to determine the mapping of all points not lying on the mesh. Also many animators used both the algorithms to create a good visual effect.

5.3. Radial Based Functions
As warping generation was done through points, lines and curves. But here in radial based function can be done through only points as we can consider curves and lines be the part of points or they are group of points. [2] This formulation permits us to draw upon a large body of work on scattered data interpolation to address the warp generation problem.

5.4. Energy Minimization
It is used for one to one warp method. Here points, polylines and curves are feature specification which are converted into group of points and then warp is interpreted into 2D generation. [2]It includes the term energy and satisfied by minimizing the sum. This method generates natural warp and its computational cost is high.

5.5. Multilevel Free Form Deformation
It is much simpler and faster method than Energy Minimization. Large performance gains are achieved by applying multilevel free-form deformation (MFFD) across a hierarchy of control lattices to generate one-to-one and continuous warp function.[2] MFFD is the extension of FFD (Free Form Deformation).MFFD was combined with Energy Minimization in Hybrid Approach.

5.6. Work Minimization
Work Minimization: As when some similar image in source and destination image so warping is not precise. Thus Gao and Soldberg implemented work minimization algorithm which derives its cost directly from the image intensities, and not from user-specified constraints. Motivated from related work conducted by the authors for solving the polygon shape blending problems, they attempted to minimize the cost associated with warping and recoloring the image [2].

VI. CONCLUSION

Our paper has described image morphing. It contains deep survey of Image Morphing in which it contains the description of different algorithms of image morphing.

It contains differentiation of the types of warping and conclude that cross dissolve method's drawback was used to overcome through warping method and these different types of warping method i.e. forward and reverse mapping are used in many algorithms and are the basic tools for every method.

Also mesh warping is the method which has full concentration on survey of image morphing and had played a major role in field of face and image transformation and has implementation of mesh warping algorithm for a triangle.

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