Image Deformation (Feature-Based Image Metamorphosis) – Interim Report, Computer Graphics Project

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1 LITERATURE SURVEY AND ALGORITHMIC DETAILS

Beier-Neely [1] proposed a new technique for the metamorphosis of one digital image into another. It is a combination of two famous image transforming techniques, *viz.*, image warping and cross-dissolve. The authors refer to this as image *morphing*. In other words, the morph process consists of warping two images so that they have the same 'shape', and then cross-dissolving the resulting images.

Cross-dissolving is simpler than Image warping. In cross-dissolve between two images, with time, we fade out the first image and fade in the second image. The intermediate image is a weighted average of the two images. For a feature point A in image 1 and a feature point B in image 2, cross-dissolve results in a new feature point F, given by:

$$F = \alpha \cdot A + (1 - \alpha) \cdot B$$

where $\alpha \in [0, 1]$

Warping between two images can be done in two ways. The authors use *reverse* image warping. In this technique, we go through every pixel in the destination image and sample the correct pixel from the source image. We make use of two algorithms: Transformation with one pair of lines and Transformation with multiple pairs of lines. In this interim report, we implement transformation with one pair of lines.

Algorithm

Consider a pair of lines mapped to each other, one in source image, say $P'Q'$, and other in destination image, say PQ.

for each pixel X in destination image
    compute u, v given the line PQ as follows:

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

$$v = \frac{(X - P) \cdot Perpendicular(Q - P)}{||Q - P||}$$

    compute X' using u, v on the line $P'Q'$:

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

$$destinationImage(X) = SourceImage(X')$$

The algorithm transforms each pixel coordinate by rotation, translation, and/or scale, thereby transforming the whole image.

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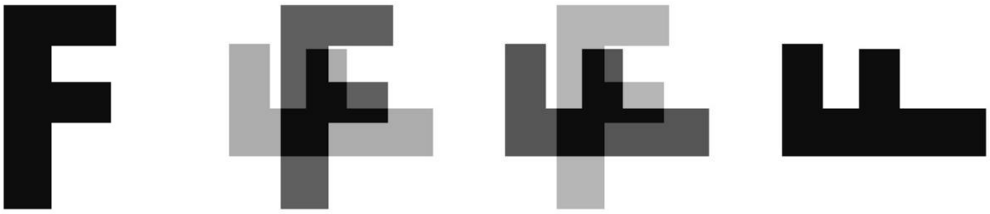
2 MILESTONES COVERED

(1) Understand the technique of cross-dissolve among image elements. Following images indicate the process of cross-dissolve between two images:

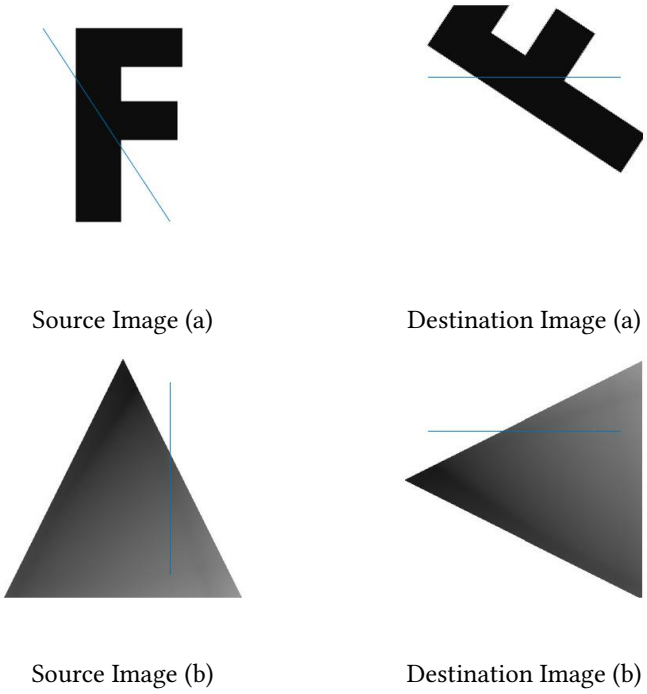


Source Image | Intermediate Image 1 | Intermediate Image 2 | Destination Image

Fig. 1. Cross-Dissolve between two images

The code for this is in file `crossdissolve.m`. It uses a function written in `intermediate.m`.

(2) Implement the algorithm of field morphing (Image Warping using Transformation with a Single Pair of Lines) as provided in the text. For this, we give two lines as input to the algorithm. The line in the source image is mapped to a line in the destination image. Since initially, we do not have a destination image, we need to input the line about which we want to transform our image. Then, we map this line to a line in the source image and use the algorithm as described earlier. Following are two sets of images, indicating the process of image warping:



Source Image (a) | Destination Image (a)

Source Image (b) | Destination Image (b)

Fig. 2. Image Warping in two sets of Images

The code for this is written in `imagewarping.m`. It uses functions `calc_u.m, calc_v.m, calc_Xd.m` and `SinglePair.m`.

3 INDIVIDUAL CONTRIBUTION

(1) Sanidhya Singal (2015085): Image Warping (Transformation with one pair of lines), Literature Survey
(2) Harshpreet Singh (2015038): Cross-Dissolve between two images, Literature Survey

Note: No third party libraries or code has been used in the project, as of now.

REFERENCES

[1] https://www.cs.princeton.edu/courses/archive/fall00/cs426/papers/beier92.pdf