A Feature Based Facial Image Morphing System

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ABSTRACT— ***Nowadays, with the rapid advances in technology, our life was filled with a variety of social media, online dating websites, forums, App…etc. Most of personal profiles demand a head shot photograph as important personal information. However, not everyone wants to show their private picture on the internet. Moreover, many people don't want to use a boring picture for representing themselves.***
Morphing is an image processing technique used to change one image into another through a seamless transition. This technique is used in many fields.
In this paper, we propose a user-friendly system to synthesize interesting facial pictures by morphing them with other features. Through a simple GUI, which enables users to manually draw feature lines, users can interactively produce vivid morphing animation from one face to arbitrary shapes. Using these pictures as head shots can not only help protecting personal privacy, but also increase the attraction of the personal profile.

Keywords--- Facial image morphing, Feature-based

1. INTRODUCTION

With dramatically evolving technology environment, social media has been an irreplaceable part of our life. Inevitably, most of the personal profiles demand a head shot photograph as a part of user's personal profile, since visual information is one of the most important sensory inputs. However, not everyone really wants to show their private daily life picture on the internet, unless he or she is satisfactory enough for the picture which is uploaded for representing themselves.
One of the possible solutions to the above problem is to provide a blended head shot picture which contains both of our facial features and certain influences from other pictures. Moreover, many of us may once dream for the ability of freely changing our facial appearance into what we like, such as the faces of celebrities, animal or other objects. Using blended pictures as profile head shot could not only protect the privacy but also present the interesting personality.
Morphing is one of the powerful tools for special visual effects. There are many extraordinary examples, one of the most famous examples is the face morphing effect in Michael Jackson's music video "Black and White", which morphed men's face into women's face in animation. The goal of morphing is to synthesize a fluid transformation from one image to another. The simplest method to perform transition between two images is Cross dissolving them. The color of each pixel is interpolated over time from the first image value to the corresponding second image value [13]. However, it is not the best performance for morphing because of artifact referred to ghosting effects [5, 14]. In order to avoid ghosting effects, it's necessary to warp and define the geometric relationship between input images before cross dissolving [1, 5]. With warped images, performed cross-dissolving two images could have a better corresponding without producing ghosting effects.
Nowadays there are many software and applications to adjust the digital image's lightness, shape, soft focus…and so on. Moreover there are some applications providing the function to transform the facial appearance into special shape like square and triangle. A variety of special effects makes people's profile picture more appealing and delight our life.
There are two main technologies wildly used for morphing: Mesh Morphing and Field Morphing [3, 4]. The differences between these two methods are as following: Mesh Morphing's algorithm is faster and the using method is simpler to users than Field Morphing's algorithm. Field Morphing consumes most of the time to draw more feature line to warp. However, the performance of Field Morphing is better than Mesh Morphing.
In this paper, we integrated these technologies and developed a user-friendly system which can synthesize facial feature ideally and produce a series of fluid transformation between two images. We implemented our system by Filed Morphing. Nevertheless, in order to reduce the necessity of drawing complex feature line for Field Morphing, we performed Face Detection to provide users with a convenient method to manipulate morphing. Our system was able to produce vivid animation of blending the feature of two images. Users were capable of choosing entertaining picture from animation as their profile head shot and enjoying the process of morphing.

2. RELATED WORKS

Morphing has been a powerful tool applied to synthesizing the feature of two images seamlessly. There are two main methods to morph: Field Morphing and Mesh Morphing. Field Morphing uses a set of line segment to align the feature of image and controls the influence of feature line by their weighted. In Mesh Morphing, meshes are assigned to each point to specify the transition behavior.

In the process of morphing, manual correspondence isn't necessary if two images were sufficiently similar. It's possible of system to morph two images with slight ghosting effects if two images are relatively similar [9]. However, in regard to morphing two totally different images, specifying the feature of images are necessary for better corresponding. There are a variety of methods to aligning the feature, one of convenient method is to specify the feature by snack which can be use easily and capture the position of feature precisely [10]. Moreover, morphing can not only be performed between two images also it is able to morph multiple images at once or morph certain part and leave other parts intact [11, 6]. There are many researches in morphing has been done, we would like to intergrade useful approaches to construct our system.

3. IMPLEMENTATION AND RESULT

3.1 System architecture

There are two main parts in our system as following (Fig. 1). First part is to align the features of input images as the morphing basis and then correspond the feature line of two images. Second part, our system could produce metamorphosis sequence images through corresponding feature line from two digital images. The detailed description will be introduced in subsequent section.

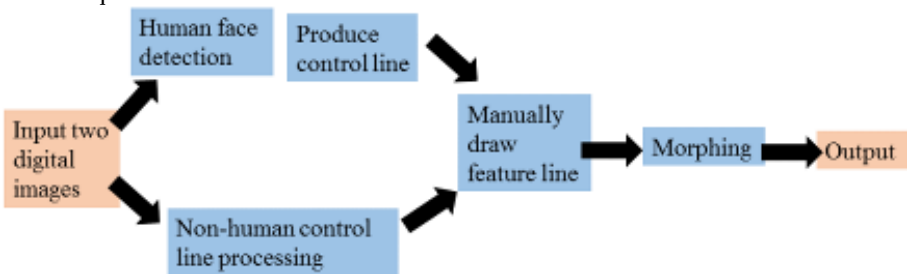

Fig.1 System architecture

3.2 Human Face Detection

Human face is a complex pattern, not to mention detecting the facial feature automatically. As for face detection, we used Intel Open Source Computer Vision Library, OpenCV. OpenCV is known as a powerful tool for image processing which its function of face detector is efficiency. In OPENCV, there are two steps for face detection. First, feature extraction which implemented AdaBoost algorithm to build classifier to distinguish human face feature. Second, Cascade Detection, use classifiers from first step to examine if the sub-windows are human face or not.

After the system detected human face, the following step is to align the feature line. For the purpose of providing a convenient interface for users to align the feature line, our system would convert the image into grayscale and then threshold the image to highlight the contour of human head. After thresholding, there was a clear distinction between head contour and background so that users could align the head contour efficiently with auxiliary feature line (Fig. 2).

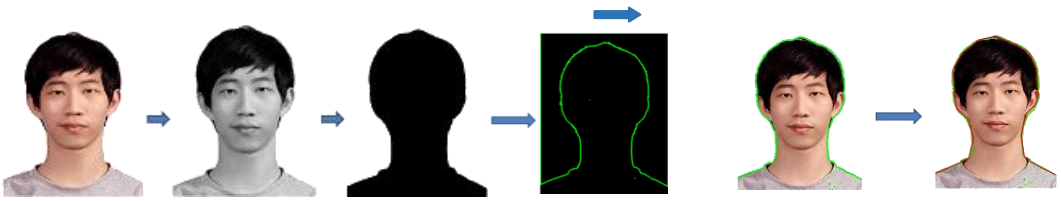

Fig. 2 Contour detection

Our system obtained the position of facial feature after face detection; however, in order to reduce the detection mistakes, we set the parameters to specify the relative position of facial features in advance. With the position of facial feature, then, in order to correspond two images, we need to build the feature line as the morphing basis (Fig. 3). The configurations of feature line based on facial detection are as following:

- Eyes feature line: Aligning from the inner corner of the eye to the outer corner of eye.
- Nose feature line: Aligning nose according to facial feature detection and aligning the nose bone bridge with line as long as two times of nose feature line's radius starting from nose center.
- Mouth feature line: Connecting the left Corner of mouth to the right corner of the mouth with a straight line.

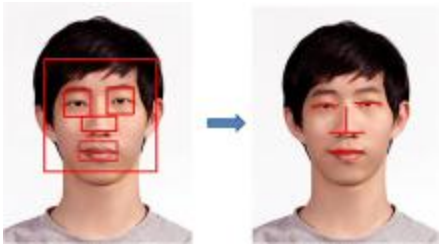

Fig. 3 Aligning face feature line

3.3 Animal Image Processing

Due to the complexity and a variety of animal face pattern, it's difficult to detect animal face automatically not to mention animal facial feature. Nevertheless, without auto detection, we observed that living beings' eyes, nose and mouth could be connected be the Chinese character"王". For the users' convenience, our system would produce eight control points depicting Chinese character"王" so that users can draw the points to the position of animal facial feature as non-human face feature line to correspond with human face feature line (Fig. 4).

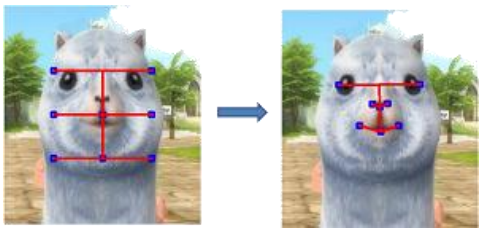

Fig. 4 Process of animal facial feature line

3.4 Correction of Failed human facial feature detection

There was a weakness of auto face detection while detecting twisted human face. Human face feature line couldn't complete successfully under the condition of exaggerated facial expression, side face, face with closed eyes, and so on. In these special cases, we used the method mentioned in section of Animal Image Processing. Our system would produce eight control points depicting Chinese character"王" and then users can assign control points to align face feature (Fig. 5).

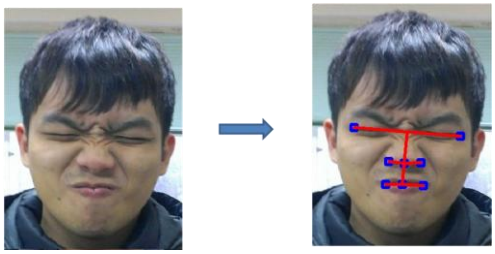

Fig. 5 Aligning human face feature line with "王"

3.5 Morphing

There are two component to morphing: warping and cross-dissolving. In order to reduce the ghost effect, our system would warp two images and calculate a corresponding relationship between each feature line in two input images according to Beier and Neely's algorithm. The Next step after warping was dissolve two image by blending relative feature line. Then our system could produce a series of fluid metamorphosis sequence (Fig. 6, 7, 8, 9).

Fig. 6 Morphing between human and animal

Fig. 7 Morphing between human and human

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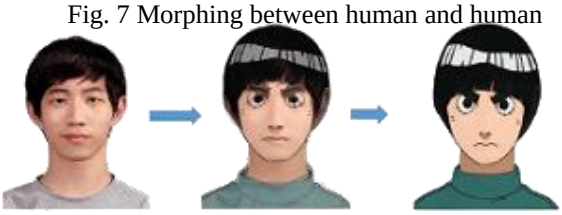

Fig. 8 Morphing between human and anime character

Fig. 9 Morphing between human and Beijing opera facial mask

4. CONCLUSION AND FUTURE WORK

For users to control the morphing results in an intuitive way, our system implemented a user-friendly interface which allows users to directly draw feature and contour lines on the source and destination images with the auxiliary information of face-detection. Through this system, it is possible for users to produce a series of interesting and fascinating images through a simple manipulation while morphing effectively.

In this paper, we focused on the transformation between human and animal or anime character. However, morphing can be wildly performed in a variety of areas such as transportation system, plants, architecture and even morph two images with rare similarity [2]. For the future work, we would like to improve the face detection to increase the accuracy of face detection [8, 12]. In order to avoid the failure of producing feature line, we would like to implement Principal Component Analysis and Hausdorff distance to increase the accuracy of facial feature detection [7]. Moreover, with the assistance of PCA, we could improve our system to establish the function of designating specific region to morphing which can increase accuracy of special pattern on animal's skin corresponding to human's detailed facial feature, for example, glasses, mustache, and eyes shadow.

5. REFERENCES

[1] Detlef Ruprecht, Heinrich Muller, "Image Warping with Scattered Data Interpolation", IEEE Computer Graphics and Applications, March 1995 Page 37 March 1995, Pages 37-43
[2] Eli Shechtman, " Regenerative Morphing" CVPR, 2010, Pages 615-622
[3] George Wolberg, "Recent Advances in Image Morphing", CGI '96 Proceedings of the 1996 Conference on Computer Graphics International, Page 64
[4] George Wolberg, " Image morphing: a survey" The Visual Computer, 1998, pages 360-372
[5] Lohmeyer, Mark Sebastian, "Digital image warping: theory and real time hardware implementation issues", Thesis (M. Eng.)--Massachusetts Institute of Technology, Dept. of Electrical Engineering and Computer Science, 1996.Includes bibliographical references Pages 93
[6] Mark Steyvers, " Morphing techniques for manipulating face images" Behavior research methods, instruments, & computers : a journal of the Psychonomic Society, Inc 31:2 1999 May Pages s 359-69
[7] Oliver Jesorsky, Klaus J. Kirchberg, Robert Frischholz, " Robust Face Detection Using the Hausdorff Distance" AVBPA '01 Proceedings of the Third International Conference on Audio- and Video-Based Biometric Person Authentication, Pages 90-95
[8] Paul Viola, Michael J. Jonesy, "Robust Real-Time Face Detection", International Journal of Computer Vision archive, Volume 57 Issue 2, May 2004 ,Pages 137 – 154
[9] Peinsheng Gao, Thomas Sederberg, " A work minimization approach to image morphing" The Visual Computer 1998 pp390 The Visual Computer, 1998, Pages 390-400
[10] Seung-Yong Lee, Kyung-Yong Chwa, Sung Yong Shin, "Image Metamorphosis Using Snakes and Free-Form Deformations" , SIGGRAPH 1995 SIGGRAPH 1995
[11] Seungyong Lee, G. Wolberg, Sung Yong Shin, "Polymorph: morphing among multiple images", IEEE Computer

Graphics and Applications, Vol. 18, No. 1, 1998, Pages 58-71
[12] Shakhnarovich, G, " A unified learning framework for real time face detection and classification" Fifth IEEE International Conference on, 20 May 2002, pages 14-21
[13] Thaddeus Beier, Shawn Neely, "Feature-Based Image Metamorphosis", SIGGRAPH '92 Proceedings of the 19th annual conference on Computer graphics and interactive techniques Pages 35 - 42
[14] Yung-Yu Chuang, Digital Visual Effects, 《Image warping/morphing》