A Face Morphing Tool for use in Psychological Research

Graham Haynes
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Supervisor: Dr. Steve Maddock
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Introduction

Morphing is an abbreviation for metamorphosis, which means to change shape or form. The term was originally used in biology to describe phases in the growth of organisms.

Today morphing is a common animation technique used to make one object appear to 'become' another. This is usually performed by setting up two warp animations – one changing the source image from the source shape to the destination shape, the other changing the destination image from the source shape to the destination shape – and simultaneously performing a cross-fade or other dissolve between them. The results can frequently be seen in films, adverts and music videos.

The shapes being morphed are usually determined by a number of points placed on the image by the user, where a point on one image has a corresponding point on the other image which relates to a conceptually identical location, e.g. identical corners. The points themselves are often part of a higher-level structure, such as directed lines or a mesh.

In addition to traditional 2D morphing, various techniques are emerging for transforming 3D shapes, and for view morphing, in which a few images of a scene can be interpolated to make a frozen-time fly-by with realistic 3D appearance, reducing effects caused by parts of objects hidden from certain angles, for instance.

Dr. Olivier Pascalis of The Psychology Department has expressed an interest in having a morphing tool for follow-up research relating to species identification from hybrid images, for example, at what point a human-monkey morphed image ceases to be human and starts being monkey. This may be done with three species images, creating a 'triangular' morph sequence. The input images will be greyscale and of a known size, and the output will be a relatively low resolution JPEG image. Display is to be handled by a data-gathering program in the Psychology Department.

My task is to construct a tool that can be used to create a morph, primarily between two 2D images, with particular consideration to the application of inter-species facial morphing, and other details specific to the requirements of the Psychology Department, which they will advise as feedback during the project.

After the Psychology Department receives a system with which they are happy the emphasis of the project will change to how the program can be improved by researching, designing, implementing and investigating techniques relating to the morphing method, user interface (including the ease and accuracy with which the morph is specified) and automation techniques, with particular emphasis on morphing faces and with consideration to any feedback from the Psychology Department. The ultimate aim is to produce a program that can be used to morph between faces of

different animals with maximum ease, minimum effort, and high quality results. Such a program could then be used in subsequent psychological research.

Analysis

As a starting point this project will use Beier and Neely's field morphing technique [2], so initial areas of research will involve maximising speed, e.g. by ignoring distant lines with weak fields, and eliminating 'ghosts' (unexpected duplications or distortions), e.g. by splitting control lines that cross or pass near each other, something that may interfere with the labelling system which I propose below. Lines that rotate substantially and independently may also cause problems, though these are unlikely to occur where a system of lines is being animated.

As the project progresses I shall attempt to investigate other techniques, such as Wolberg's spline mesh morphing [6] and snake [3] proposals, as well as variations on constraining techniques which may be applied in order to maximise realism, such as Surazhsky and Gotsman's triangular method [5] and Alexa, Cohen-Or and Levin's rigidity method [1]. I will also look briefly at how such two dimensional techniques have been extended into 3D, e.g. wires [4].

The most time-consuming part of specifying a morph involves picking corresponding points on the two images in what is sometimes a clunky interface. To remedy this situation I propose to investigate semi-automation techniques, such as snapping points to the most extreme pixel when a local edge detection filter is run.

I propose also to design a hierarchical labelling system for the morphing components. This would allow images to be individually edited. Simply selecting two annotated images would then specify the morph by automatically creating correspondence between matching labels. The tree, or branches thereof, could be imported or exported to a template library, which would allow drag-drop placement of shapes. This would also help to address the issue of varying features between the faces of species. Branches could be resized or moved as a group, allowing editing of several points at once. Unfortunately this additional flexibility may result in a slightly steeper learning curve for the user.

All of these proposals, of course, have their own problems. These will be fully investigated in the project, the exact nature of which may vary as it progresses. My targets are subject to available time.

References (A selection)

[1] Alexa, M; Cohen-Or, D. and Levin, D, "As-Rigid-As-Possible Shape Interpolation", SIGGRAPH 2000

[2] Beier, T. and Neely, S, "Feature-based image metamorphosis", SIGGRAPH '92

[3] Lee, S; Chwa, K; Shin, S. Y. and Wolberg, G, "Image Metamorphosis Using Snakes and Free-Form Deformations", ACM, 1995

[4] Singh, K. and Fiume, E, "Wires: A Geometric Deformation Technique", Alias|wavefront

[5] Surazhsky, V and Gotsman, C, "Controllable Morphing of Composite Planar Triangulations", ACM Transactions on Graphics, Vol 20, No 4, October 2001

[6] Wolberg, G, "Digital Image Warping", IEEE Computer Society Press, 1990

Plan of Action - A rough plan of how the project is to proceed, as predicted at the start of the project.

Week	Research	Programming	Other	Deadlines
Summer 2002,2003	Initial research, primarily on morphing techniques.	Work on a basic morphing program.		
Intro Week	Continue research.	Continue programming.	Report progress to Psychology Department.	
Week 1	Continue research.	Start finalising basic working system for release soon.	Meet with Psychology Department to discuss ideas further.	
Week 2	Continue research.	Complete basic morphing functionality	Prepare evidence of working system.	Project description.
Week 3	Literature review; morphing software.	Implement loading/saving of data and images; useable UI; Process feedback.	Release working system; possibly observe usage; receive feedback.	
Week 4	Literature review; morphing software.	Localised edge snapping; applet functionality; UI; feedback	Release working system if needed; receive feedback.	
Week 5	Literature review; morphing software; types of morphs.	Component tree; eliminate morph problems; UI; feedback.	Ensure all introductory sections are written; release working system; receive feedback.	
Week 6	Facial feature identification; applications of morphs.	Face templates; eliminate morph problems; UI; feedback.	Release working system if needed; receive feedback.	
Week 7	Facial feature identification.	Face templates; eliminate morph problems; UI; feedback.	Release working system; receive feedback.	
Week 8	Biometrics and face recognition.	Address outstanding issues.	Release working system if needed; receive feedback.	(Survey and Analysis Draft)
Week 9	Biometrics and face recognition.	Address outstanding issues.	Release working system if needed; receive feedback.	
Week 10	Biometrics and face recognition.	Address outstanding issues; improve methods used to specify the morph with a view to automation	Release working system if needed; receive feedback.	Survey and Analysis
Week 11	Automatic morphing.	Address outstanding issues; semi-automation.	Release working system if needed; receive feedback.	

Week 12	Automatic morphing.	Address outstanding issues; semi-automation.	Release working system if needed; receive feedback.	
Christmas	Automatic morphing; evaluate UI.	Address outstanding issues; UI cleanup; working with curved lines and splitting lines.	Release working system if needed; receive feedback.	
Weeks 13-15	Improved realism.	Address outstanding issues; working with curved lines and splitting lines.	Release a system that can be considered final by meeting the requirements of the Psychology Department.	
Week 1	Improved realism.	Add morphing techniques and tweaks, or extend automation.	Enquire about binding.	(Psychology data collection begins)
Week 2	2D morphing techniques applied to 3D.	Add morphing techniques and tweaks.		
Week 3	2D morphing techniques applied to 3D.	Add morphing techniques and tweaks.	Initial Psychology project feedback?	
Week 4	2D morphing techniques applied to 3D.	Add morphing techniques and tweaks.		
Week 5	Compare methods.	Add morphing techniques and tweaks.		
Week 6	Compare methods.	Address outstanding issues.		
Week 7	Compare methods.	Address outstanding issues.		
Week 8	Address outstanding issues.	Address outstanding issues.	Psychology feedback?	
Easter	Address outstanding issues; evaluate UI.	Implement latest feedback and ideas; UI cleanup.		
Week 9	Address outstanding issues.	Check adequate documentation; prepare demonstration for poster session.	Format project for printing.	
Week 10	Address outstanding issues.	Prepare demonstration for poster session.	Format project for printing; prepare CD; prepare poster.	Final
Week 11		Prepare demonstration for poster session.	Prepare poster.	Poster session; vivas.
Week 12				Vivas.