

Creating Panoramas and Eliminating Ghosting

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Abstract – A panorama is any wide-angle view or representation of a physical space, whether in painting, drawing, photography, film/video, or a three-dimensional model. Panoramic photography soon came to displace painting as the most common method for creating wide views. As panoramic photography becomes increasingly popular, there is a greater need for high-quality software to automatically create panoramic images. Existing algorithms either produce a rough "stitch" that cannot deal with common artefacts, or require user input. Our first contribution is a method for dealing with objects that move between different views of a dynamic scene. If such moving objects are left in, they will appear blurry and "ghosted".

This paper gives analysis of methods for creating panoramas and resolve problems during image stitching using blending algorithm.

Keywords – Panoramas, image stitching, image blending, "ghosting".

INTRODUCTION

A panorama is a picture that is made by combining a series of photos into one large picture. By combining a series of photos, you can provide a complete view of an area or location that cannot fit in a single shot. Panoramas are usually made by taking a series of photos across a horizontal (or, at times, vertical) line. The word "panorama" indicates an unbroken view, since a panorama can be either a series of photographs or panning video footage.

One of the problems in automatic image stitching is that of de-ghosting. When the images are taken, there is no guarantee that objects in the image stay stationary from one image to the next. This becomes a problem in the areas of overlap between images. When the images are stitched together, we take a composite of the overlapping images in order to create a smooth transition between neighbors. However, if regions of the scene are not stationary, the overlap image will be slightly different in each image contributing to the overlap. Thus, those regions of the composited image will contain combinations of pixel values from entirely different parts of the scene. For example, if a person moves his head in an area of overlap, the region containing his head in the stitched image will be a combination of head and background from both images. It will give the head a ghosted look, not to mention that this ghosted head will appear in two locations.

II. METHODS OF CREATION PANORAMAS

There are many methods of creation panoramas. You can produce any type of panoramas with any type of camera, digital or analog. Depending on the lens you usually stitch 8-16 images for a 360° panorama. Wide angle lenses with coverage of 60 degrees or more are usually used. The images are taken with 20%-50% overlapping. Important for all panoramas: [1]Use manual mode with same exposure for all images. [2]If possible do not use automatic white balance. [3]Use a tripod with a special panohead which rotates the camera around the nodalpoint.

Fisheye lenses are popular for spherical panoramas as you can cover a full view with only 3-8 images. To be able to make a full spherical with 3 images you need a full circle of min 180°. This can be done by using a 35mm film camera or a fullframe digital and an 8 mm fisheye.

Fullframe Fisheye lenses usually 15 - 16 mm has been used for many years for panoramas with 35 mm cameras. The quality is much better than with the 8 mm fisheyes but they need 6-8 images around + top and bottom images.

One shot 360° panoramic solutions are parabolic mirrors which can be used as an add on to many digital cameras. The resolution is low and the quality is also affected by the quality of the mirror.

Digital panoramic scanning cameras can make very high quality panoramas but the price is also high.

One popular method of creation is to stitch photographs taken from the same point in space but of varying pitch and yaw in order to create a panoramic image which, when rendered using appropriate software (usually through web browser plugins), allows the end user to pan and zoom at will.

The benefit of this method is that it does not require any specialized equipment to capture the images, although using such can greatly speed up the process and render a higher quality result. This photographic technique results in a limited depth of field, meaning that the space may appear warped.

Image stitching or photo stitching is the process of combining multiple photographic images with overlapping fields of view to produce a segmented panorama or high-resolution image. For image segments that have been taken from the same point in space, stitched images can be arranged using one of these graphical projections:

Rectilinear projection, where the stitched image is viewed on a 2D plane.

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Cylindrical projection, where the stitched image shows a 360° horizontal field of view and a limited vertical field of view. Panoramas in this projection are meant to be viewed as though the image is wrapped into a cylinder and viewed from within. When viewed on a 2D plane, horizontal lines appear curved while vertical lines remain straight.

Spherical projection, where the stitched image shows a 360° horizontal by 180° vertical field of view. Panoramas in this projection are meant to be viewed as though the image is wrapped into a sphere and viewed from within. When viewed on a 2D plane, horizontal lines appear curved as in a cylindrical projection, while vertical lines curve as they get closer to the poles of the sphere.

The workflow of this method of creation panoramas with stitching photographs taken from the same point in space but of varying pitch and yaw includes:

- [1] Browsing folder that contains the photos taken from the same point in space
- [2] Detecting panoramas
- [3] Editing panoramas (cropping)
- [4] Save and render panoramas

III. TIPS FOR TAKING PHOTOS FOR YOUR PANORAMA

When you are taking the photos that you plan to use in your panoramas, here are a couple of quick tips that can help you to make better panoramas more quickly.

Take a few practice shots. Before you take the sequence of pictures, make sure that the photo quality is good. When taking your practice shots, make sure you take pictures in different parts of the scene because the lighting can change from one part of the scene to the next. However, make sure that you have high-quality photos to start with and use in your panorama.

Mark the point where the sequence of photos begins and ends. Before you take the first photo that you plan to use in your panorama and after you take the last photo that you plan to use, "mark" the place where the sequence of photos begins and ends. For example, you could mark the place where the sequence starts by taking a photo of something unrelated, such as the ground, a blank sheet of paper, or another unrelated object. Do the same at the end of the sequence. This is helpful to do especially if your camera does not have a mode for taking digital photos for a panoramic images. If you do not want to take up storage space on your storage card with these unused shots, another way to mark the beginning and end of the sequence is to simply write on paper the name and number of the first and last photo in the sequence of photos that you plan to use in your panorama.

Use a tripod when you take the photos to help keep the camera level across the sequence of photos you take. Also, using a tripod lets you smoothly pan horizontally across the scene from one part to the next. Tripods come in many different sizes, so choose one that will work well for your needs.

Make sure there is overlap between one photo and the next. When taking the photos, make sure that each photo overlaps the other by at least one-third or half. This prevents gaps from appearing in your final panorama. In the following image, the amount that the two photos overlap is shown in the area that is shaded white.

Minimize the number of fast moving objects in your photos. If possible, minimize the amount of fast moving objects you have in each photo that you take. Fast moving objects will move from one part of the scene to the next. Therefore, you might only capture half of the object in the final panoramic, or the moving object might appear two times in your final panorama. This might occur if the object moves from one part of the scene to the next, and you take different photos that have the same moving object in different parts of the landscape.

Keep the focal length consistent throughout your photos. As you take one photo and then another, be careful not to zoom in or zoom out.

IV. IMAGE BLENDING

One of the problems in automatic image stitching is that of de-ghosting. When the images are taken, there is no guarantee that objects in the image stay stationary from one image to the next. One way to resolve the problem of "ghosting" is using blending algorithm.

A blender is an algorithm aiming at blending two images (or more) together. The goal of the blender is to produce a resulting image where no transition can be seen between the original source images.

The following blenders are available:

None: no blending is performed; the "top picture" is used. The stitching seams are obviously visible (geometry and/or brightness).



Fig.1 None

Linear: this mode is very fast and can be a good compromise between quality and speed if you are not too demanding on quality.



Fig.2 Linear

Multiband: this slower mode will produce much better results than the "Linear" mode. The transitional areas between images will hardly be visible. However this mode does not take into account objects that could have moved from one shot to another and some "ghosting" can occur.



Fig.3 Multiband

Smartblend: this blender combines a Multiband blender and picture analysis engine in order to identify common objects present in the source images (a moving object, a strong line..). Based on the results of this analysis, Smartblend tries to keep the features common between images (edges, lines, curves,) and automatically discard objects that have moved between shots. Even though much slower than the other algorithms, this blender produces a much higher rendering quality. Be aware: this blender is not HDR compatible yet. Smartblend, very often, is the best blender: it does a better job at harmonizing the colors, even when no color correction is applied. It prevents “ghosting”, and produces a sharper image than Multiband.



Fig.4 Smartblend



Fig.5 Example of “ghosting”

You have to know that smartblend is using a pyramidal blender like in a multi-band approach, plus a seams detection algorithm that will find where to cut pictures.

Smartblend parameters

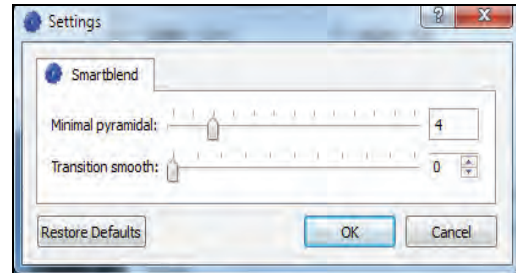


Fig.6 Smartblend parameters

Minimal pyramidal

This parameter indicates the number of stages the blender should use. It's not coded as a pyramid level but as a stop condition. When reaching this value (in pixels), it stops the building of the pyramid for the blending. So, if you have 4096, the blender will not do any level of the pyramid as the end condition is reach at first stage. The default value is 4 pixels. That's really short but allow to have large color equalization over large areas.



Fig.7 Minimal pyramidal 4 - The blend is done over large zone making a good equalization of color



Fig.8 Minimal pyramidal 16 - You can see that just changing the value a little, it can have a large influence on the result.



Fig.9 Minimal pyramidal 64



Fig.10 Minimal pyramidal 256



Fig.11 Minimal pyramid 1024



Fig.12 Minimal pyramid 4096

Transition smooth

This value tells how sharp the transition has to be done between both pictures. It's not exactly like the first parameter as it doesn't work on pyramid number of levels but directly on images and how they are blended together at each pyramid stage. This value in fact allows a kind a linear blend on the transition zone.

This study shows the influence of Transition smooth only. I put 4096 as Minimal pyramidal value to prevent its influence.



Fig.13 Transition smooth 0 pixels, Direct blend, no smooth transition



Fig.14 Transition smooth 8 pixels, A small smooth transition



Fig.15 Transition smooth 16 pixels, A fairly large transition



Fig.16 Transition smooth 32 pixels, A really large transition zone over 32 pixels

Another way to resolve the problem of “ghosting” is to edit pictures in appropriate program for editing raster images (Adobe Photoshop) and using Brush tool with seamless colour to overlay the objects which are not mutual in every picture. After this there will not be any problem with image stitching.

IV. CONCLUSION

A panorama is a picture that is made by combining a series of photos into one large picture. By combining a series of photos, you can provide a complete view of an area or location that cannot fit in a single shot. But, while creating panoramas in appropriate software the problem of “ghosting” must be resolved. One way to resolve this problem is to use Smartblend algorithm for blending pictures, and another is to edit pictures before they've been stitching (in appropriate program for editing raster images - Adobe Photoshop). Panoramas can be used in many areas, but the most popular is using them for creating virtual tours. Virtual tours are popular today because of their wide area of implementation.

REFERENCES

- [1] Malcom Kesson, An Introduction to 3D Computer Graphics. Malcom Kesson, 1995.
- [2] Anne Morgan Spalter, The Computer in the Visual Arts. Adision – Weesley, 1999.
- [3] James D.Foley, Andries van Dam, Steven K.Feiner, John F. Huges, Richard L. Phillips, Introduction to Computer Graphics. Adision – Weesley, 1993.
- [4] Igor Nedelkovski, Computer Graphics, 3D Modeling and Animation. Faculty of Technical Sciences - Bitola 2008.
- [5] <http://www.freepatentsonline.com>
- [6] <http://citeseerx.ksu.edu.sa>
- [7] <http://www.computer.org>
- [8] <http://www.autopano.net>
- [9] <http://www.easypano.com>
- [10] <http://www.canoma.com>
- [11] <http://www.wikipedia.org/>
- [12] <http://www.0-360.com>
- [13] <http://www.panoramas.dk/>
- [14] <http://www.panoguide.com>
- [15] <http://www.thegnomonworkshop.com/>
- [16] <http://www.cambridgeincolour.com>
- [17] <http://www.commission5.isprs.org>
- [18] <http://www.goodtutorials.org/>
- [19] <http://www.photomodeler.com/>