

Spherical Mosaic

CS 4475: Project 6

1 - Objective

For this project, you will shoot six or more pictures of a scene, and then use the provided code to assemble these images into a spherical mosaic. There is no programming for this assignment.

2 - Deadline

Your project should be submitted on T-Square by 11:55PM on Monday, June 30, 2014.

3 - Process

3.1 Download the base source

Download and unzip the provided zip file for this project. Try out the provided code using the example images that are already in the “data” directory.

3.2 Project description

Your first task is to take a bunch of pictures of a scene or a subject in such a way that you will later be able to assemble them into a spherical mosaic (that is, a panorama). See the check-list below so that you know the requirements for the photos that you take. You should choose a scene so that everything in the images is fairly far from the camera. If objects are too close to your camera, they will be more difficult to register to one another. Outdoor scenes are likely to work the best. When you shoot the images, make sure that you keep the camera in the same place and only rotate the camera in the “yaw” (left/right) and “pitch” (up/down) directions. Avoid rotating in the “roll” direction, since the provided code does not handle this. Remember, try to pivot the camera around its center, and do not translate the camera. If you can borrow a tripod, this is an excellent tool for taking photos for a spherical mosaic. It is quite possible, however, to take a good set of spherical mosaic photos by hand. You will have an easier time assembling your mosaic if all of the photos are taken at the same focal length (zoom), but whether or not you change this is up to you.

When you are taking the pictures for your mosaic, you should make sure that each photo overlaps with at least one other photo in your collection. That way, you can avoid having holes in your mosaic. People often shoot in a grid-like way, first taking a row of shots across the top of the scene (vary “yaw” left to right), then moving down (vary “pitch”) and shooting another row of photos, and so on.

Once you have taken your photos, you may want to convert them to lower resolution pictures before you load them into the mosaic code. If they are too high resolution, the code will be sluggish. Try to keep the resolution under 800 pixels vertically and horizontally.

When you are ready to use the spherical mosaic program, place your photos into the “data” directory. Then, edit the code in the “setup()” routine (about $\frac{3}{4}$ of the way down), modifying this code so that all of your images are read into the array “views”. You will also have to set the focal length, which is currently set to $f = 543$ in the code. You may be able to determine the focal length of your images from the EXIF information in the images. For fixed focal length cameras (like cell phones), you may be able to determine its focal length by searching online. If neither of these methods are applicable, you may have to experiment. See the notes below on focal length calculations for more details. As part of this assignment, you will turn in a short text document that says how you determined the appropriate focal length for your images.

Once you have taken the above steps, you are ready to interactively assemble your spherical mosaic. The program allows you to drag the current image with the mouse. The current image has its color made slightly more red, so that you can see which image you are currently moving with the mouse. The images will be low-

resolution while you drag them, but will go to high resolution once you release the mouse. You can change which image is “current” by typing a digit from 1 to 9. If you have more than 9 images, then you can use the left and right arrow keys to decrease or increase the current image counter. You can also use the mouse wheel to scroll through the different images. If you hold down the “f” key while dragging, you will change the focal length for the current image instead of moving it. Pressing the 0 key will de-select all images, so that none of them have their color altered. When you are ready with your final mosaic, de-select all images and then press the “s” key to write your final mosaic to the file “out.png”.

Here is a checklist of items that you should accomplish while making your spherical mosaic:

- Use at least six images in your mosaic.
- The images used for this assignment should be different than those used in prior assignments like the Hockney-style mosaic.
- Make sure that you shoot your photos in a manner so that some of them will need to be offset vertically, and others will be offset horizontally. That is, you should vary both “yaw” and “pitch” (possibly at different times) while you are taking your collection of photos.
- Use a focal length setting for your images that is close to the actual focal length used to take the pictures. See notes below on focal lengths.
- Make sure there are overlaps between adjacent photos, so that there are no gaps or holes in your final mosaic.
- Don’t overlap your photos too much, thus making it trivial to align them.
- Do your best to properly align the photos using the spherical mosaic program. Your alignment by hand will not be perfect, but try hard to avoid obvious misalignments.

3.3 Focal Length Calculations

Probably the trickiest part of this assignment is the calculation of the focal lengths for your images. (Note that you will turn in a brief description of how you calculated focal length.) Normally, focal lengths are given in millimeters (mm), since this is also the units that are typically used to measure sensor widths. In the spherical mosaic program, however, it is expecting the focal length to be measured in terms of *pixel units*. This value is set in the setup() routine, in the variable “f”. Here is the equation for converting mm focal length values to pixel units:

$$f_in_pixels / width_in_pixels = f_in_mm / width_in_mm$$

or

$$f_in_pixels = width_in_pixels * (f_in_mm / width_in_mm)$$

As an example, the three example images for the program are all 640x480 pixels in size. Thus the value `width_in_pixels = 640`. The EXIF information for these images says that the focal length is 3.85mm, and this is `f_in_mm`. The sensor width for the iPhone 4 is 4.54mm, and this is `width_in_mm`. This means that the correct focal length value in pixel units is $640 * (3.85 / 4.54)$, and this give a value of about `f_in_pixels = 543`. For this reason, the value `f` in `setup()` has been set to 543.

Be careful to note: If you change the size of your images (so that they display faster in the spherical mosaic program), you will have to take this new width into account when setting `f`. If we scale down the size of the example images by a factor of two (so `width_in_pixels = 320`), we would have to change `f` to be $543/2 = 271$.

3.4 Submission

For this project, create a directory that contains the screen shot of your final mosaic and a sub-directory called “data” that contains the individual images that you used for your mosaic. In addition, include a short text file inside this directory that describes how you calculated focal length `f` for your images, including the relevant values and the final answer `f`. Zip up this whole directory (final mosaic + focal length text + original images) and turn it in on T-square.