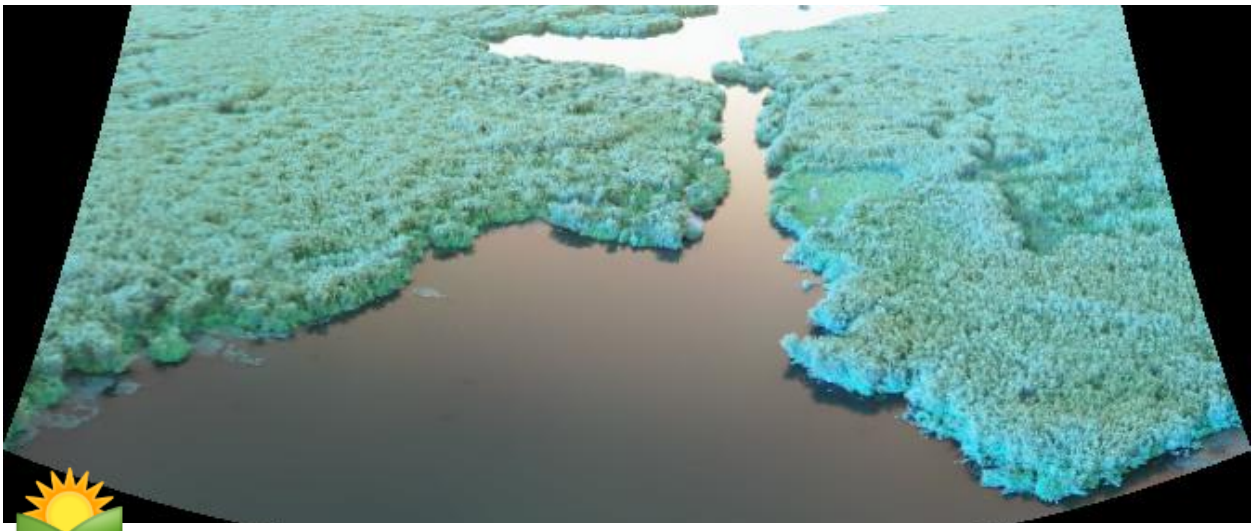

CV - Panorama generator

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Description

Feature detection and matching are powerful techniques used in many computer vision applications such as image registration, tracking, and object detection. In this example, feature based techniques are used to automatically stitch together a set of images. The procedure for image stitching is an extension of feature based image registration. Instead of registering a single pair of images, multiple image pairs are successively registered relative to each other to form a panorama.

To construct our image panorama, we’ll utilize computer vision and image processing techniques such as:

- keypoint detection and local invariant descriptors

- keypoint matching
- **RANSAC**
- perspective warping.

Approach

First of all, the videos were parsed frame by frame and converted to images in associated folder in order to select the best one (manually) for the image stitching process.

The resulting folders were named the same as the video for easy identification.

```
drwxr-xr-x  1501 andreipopescu  staff    47K Jan  9 13:08 Delta_Crisan_1_test.mp4
drwxr-xr-x   848 andreipopescu  staff    27K Jan  9 13:05 Delta_Crisan_1_train.mp4
drwxr-xr-x   599 andreipopescu  staff    19K Jan  9 13:06 Gura_Portitei_1_test.mp4
drwxr-xr-x   521 andreipopescu  staff    16K Jan  9 13:06 Gura_Portitei_1_train.mp4
drwxr-xr-x   906 andreipopescu  staff    28K Jan  9 13:09 Gura_Portitei_2_test.mp4
drwxr-xr-x   479 andreipopescu  staff    15K Jan  9 13:08 Gura_Portitei_2_train.mp4
```

Second, we will compute the SIFT / ORB / SURF -keypoints and descriptors of the two images; and distances between every 2 descriptors of the two images. Third, we will select the top M matches for each descriptor of both images. Next, we estimate the homography matrix and align the 2 pictures for stitching. Finally, we stitch the two images to create a beautiful panorama.

Compute the SIFT keypoints and descriptors

A Scale Invariant Feature Transform (SIFT) feature or keypoint, is a selected circular region of an image with an orientation.

It is described by 4 parameters :

- The keypoint center coordinates x and y
- Its scale : the radius of the region
- Its orientation (an angle expressed in radians)

A SIFT detector searches for keypoints of different sizes at different positions in the image.

Each SIFT keypoint has a descriptor associated with it. A SIFT descriptor is a 3-D spatial histogram of the image gradients, characterizing the appearance of a keypoint. The gradient at each pixel is regarded as a sample of a 3-D elementary feature vector, formed by the pixel location and the gradient orientation.

Now that we have SIFT keypoints and descriptors, we need to find the distance of each descriptor of image 1 to each descriptor of image 2.

Next, we select the top M matches of the descriptors. Here, we are taking the value of M to be 2, you can experiment with other values of M as well. Even in the top 2 descriptors, we may have obtained some trivial descriptors. We eliminate those with ratio test.

Two images of a scene are said to be related by a homography under two conditions:

- The two images are that of a plane e.g. sheet of paper, credit card etc.
- The two images were acquired by rotating the camera about its optical axis.

We calculate the homography matrix of the 2 images, which require atleast 4 matches, to align the images. It uses a robust technique called Random Sample Consesus (RANSAC), which produces right results even in presence of bad matches.

Once we have the homography for transformation, we can warp the image and stitch the two images.

Results

Note: The main problem in the development flow is regarding the images, which are not adapted for panorama generation as they don’t have a large number of similar points to be merged.