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An Application of Feature Based Image Mosaicing Algorithm with RANSAC in Road Traffic Congestion Control System

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ABSTRACT

An Image Mosaicing algorithm of feature based is presented in this research paper. A relaxation based correspondence algorithm is used to first select corresponding corners in two images. A RANSAC algoritham is used to find the homography relating the two images. The resulting homogrphy is refined by applying Newtons non-linear method. A dynamic programming based blending algorithm was used to seamlessly blend the two images.

1. INTRODUCTION

Image Mosaicing is an area of research in computer vision. It also has the applications in Intelligent Road Traffic Congestion Control System. There is variety of methods used for Image Mosaicing techniques. they can be generally categories into Direct methods [Shum], [Szeliski] and Feature based methods [Faugeras],[Hartley],[Capel].Direct method is helpful for mosaicing large overlapping regions, small translations and rotations ,while Feature based methods can usually handle small overlapping regions Generally they are more accurate but exhaustive computationally.

There are some of the basic problems in Image Mosaicing are the following:

1. Correcting geometric deformations using image data and/or camera models
2. Global alignment: It is the calculation of the transformed (homography), which aligns two images.
3. Image registration using image data and/or camera models. This might cause ghosting or blur in the blended image.

4. Automatic selection of images to blend from a given set of images.
5. Eliminating seams from image mosaics Image blending: After one of the images has been transformed using the Homography calculated above a decision needs to be made about the color to be assigned to the overlapping regions. Blending also becomes important when there exists a moving object in the Images taken.

This describes that various approaches taken by the author and the improvements achieved. Most of the Result is shown using two images to illustrate the improvement in quality achieved at each stage. The algorithm is described stepwise in the proceeding sections.

2. To Sort out the Correspondence

To Calculate Homography, only four corresponding points are required in two images relating the two points. Pratically, a large number of points are detected on the two images and correspondences are solved. The problem of solving correspondences is an extremely complicated. In this paper, Harris corner detector is used to detect corners and a customized version of the algorithm proposed in [Zhang] is used to solve for correspondence. The steps of the algorithm are as follows:

(A). matching by Correlation: its corresponding neighborhood is searched in another image, for each corner detected in a image. These corners in second image are labeled as candidate matches whose neighborhood is similar to the corner detected in the first image. Hence, corresponding to each corner in the first image there could be multiple candidate matches. The correlation coefficient between the neighborhood of corners in the first image and second image is taken to the measure of similarity.

(B). Disambiguating Matches Through Relaxation: The match strength for a particular match is more if, in a small neighborhood of that match, there exist other matches, which are related by a similar transform as the match in question. The underlying assumption is that, corners in a small neighborhood can be thought to be transformed by an affine transform. Using this criterion, a strength matrix SM is formed whose rows represent the corners in first image and columns represent the corners in second image. Those entries which are both the highest in their respective rows and columns are chosen as matches. The correspondences find using the above technique are given in figure 1.

Figure 1: Corners in the above two Images

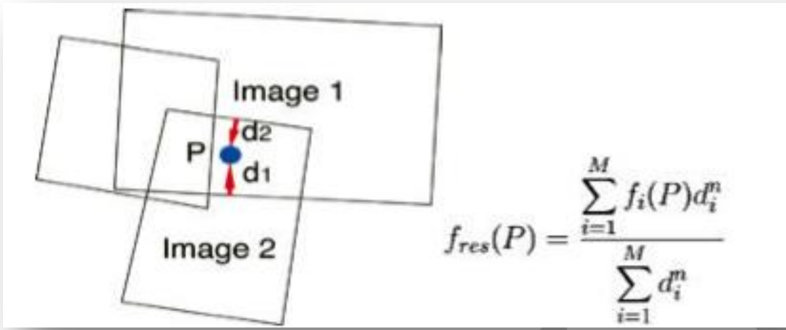
3. Calculation of Homography

Homography relating the two images was estimated using Random Sample Consensus (RANSAC). RANSAC implementation is getting a remarkable improvement over Least Squares Estimation of Homography. The progress is given in the results below:

Figure 2. LHS: Mosaic using Least Squares, RHS: Mosaic using RANSAC

4. Image Blending:

In Figure 2, we observed that, even though RANSAC gives good estimate of homography and images are aligned, there is a visible line along the boundary of the overlapping region. Hence, the mosaic is not seamlessly blended. Two methods are used to blend the mosaics seamlessly. (A). Weighted Image Blending: Every pixel is weighted with the distance to the closet image boundary to the nth power



(B). Cut along the lightest path: The difference of the overlapping regions of the two images is taken and a vertical curve is drawn along the lightest intensity path to divide the overlapping region into two parts. Each image contributes to a single part of the overlapping region. The algorithm was implemented using Dynamic Programming. The lightest path is chosen for the cut because it is least discernible. The recursive dynamic programming equation is given by:),,min(,1,1111, −+−−−+= ijijijijij EEEeE ,where e is the value of the current pixel in the difference image. E is the cumulative weight as shown above. The above implementation is however not optimal cut although the results look good. The cut along the lightest path is shown the figure given below.

Figure 3. LHS: The path taken by the cut; RHS: Blended Image.

The lightest cut algorithm, unlike the weighted image algorithm, doesn't produce any blurring.

5. Homography Refinement

The Calculation of the Homography can be refined considerably by using a non-linear method of optimization after RANSAC algorithm implementation. In this paper Newton's method was used to refine the Calulation of homography. Newton's method is only stable near minima but has quadratic convergence. However, the estimate of homography found using RANSAC brings the cost function close to minima. Hence, using Newton's method for estimating homography is justified. The result of Estimate of homography can be best appreciated if we zoom into blurry regions of a mosaic blended using weighted blend.


Figure 4 LHS using RANSAC showing a blend RHS using RANSAC algorithm followed by the non-linear optimization shows a blend

DRAWBACKS:

A Major drawbacks of the implementation is that I missed the point that mosaicing of multiple images cannot be achieved by repeatedly warping new images to one reference image. Hence, after mosaicing four images to the reference image, the image alignment is not look good.

CONCLUSION:

In this paper, some good and standard approaches for Image Mosaicing were applied. The approach is to cut the overlapping regions of the images along the curve of minimum brightness in the difference image was a good idea, but its implementation is not as straight forward as in texture synthesis application (from where the idea was borrowed). One of the key observations is that non-linear methods should be used after RANSAC to refine the estimate.

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