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A Survey on Panoramic Image Matching by Combining Harris with SIFT Descriptor

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ABSTRACT: The input taken from different viewpoints are stitched using this image stitching to produce visually realistic panoramic images. This approach allows wide baselines between images and non-planar scene structures. It is a mesh based framework to optimize alignment and regularity in 2D.Constructing the panoramic images, which are locally as perspective as possible and yet nearly orthogonal in the global view. Thu composition can be improved and achieve good performance on misaligned area. The key of constructing the measurable aerial panorama is to obtain the position and poseur of the aerial panoramic image. This approach will overcome the problem of measuring the aerial panoramic image, by obtaining the geographical location information of the image.

KEYWORDS: Image stitching, mesh based framework, composition, panoramic image.

I. INTRODUCTION

Nowadays, the usage of smart phones and digital cameras has been increased. Thus camera lens only have capability of capturing the limited of field of view for panoramic shooting mood. It is understood that panoramic image capturing is tedious process which consists of various factors. The main drawback of producing a large field of view for a close object, the shifting of camera is needed to capture various regions which lead to problem of constructing panoramic image. Images produced from different camera lens have multiple challenges. This problem can be eliminated by considering non ignorable base lines among multiple cameras. All previous image stitching methods uses simple camera rotation techniques. While taking these assumptions which leads to severe problem. Since the old methods use SIFT for correspondence which does not produce 360 degree panoramic image. We are proposing a Harris algorithm for corner point detection where we can achieve optimized and well constructed 360 degree panoramic image. Our main approach is using grid based frame work enhancing image alignment. Scale preservation is used to obtain alignment partially parallel to the image plane.

II. RELATED WORK

In [2] algorithms for aligning images and stitching them in to seamless photo mosaics are among the oldest and most widely used in computer vision. The drawbacks of this stitching are 1) While determining image pixels, there occur pixel to pixel dissimilarities between two images.2) By estimating image stitching approach overlapping occur between two images so the view may not be seen correctly.3) output images cannot be rendered accurately so no texture mapping between the images. In [4] while taking images from the aerial view such as aircraft, satellite the ground control points cannot be predicted exactly. Here one image does not compared with all other images. It selects one image as reference and wraps other images to it which causes large perspective distortion. In [6] there occur strip panoramas, the variance of strip panoramas exhibit distortion for scene with varying depth. Therefore the resolution is low and noise is present. In [11] error metric must be chosen to compare the images. It should try possible alignment to do image stitching. In case of general camera rotation an 8 parameter planar perspective motion model which is more robust.

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III. PROPOSED ALGORITHM

HARRIS ALGORITHM FOR CORNER POINTS DETECTION:

A corner can be defined as the intersection of two edges. The interest point is a point, a well defined position in an image. The quality of the corner detector is determined by its ability to detect the same corner in multiple similar images even under lightening, translation, rotation and other transforms.

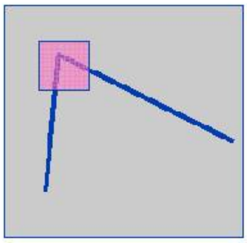
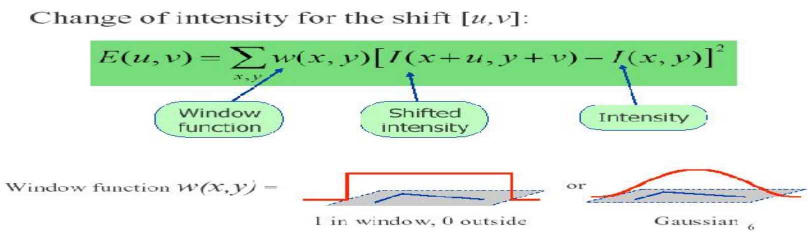


FIG 1: INTENSITY WINDOW

In fig 1: We should easily recognize the point by looking at the intensity values within a small window. Shifting the window in any direction should yield a large change in appearance.

Harris corner detector gives a mathematical approach for determining the corner points:



$$f(x+u, y+v) = f(x,y) + uf_x(x,y) + vf_y(x,y) +$$

$$\frac{1}{2!}\left[u^2 f_{xx}(x,y) + uvf_{xy}x,y + v^2 f_{yy}(x,y)\right] +$$

$$\frac{1}{3!}\left[u^3 f_{xxx}(x,y) + u^2 v f_{xxy}(x,y) + uv^2 f_{xyy}(x,y) + v^3 f_{yyy}(x,y)\right]$$

HARRIS CORNER DETECTION ALGORITHM:

1. Compute x and y derivatives of image

$$I_x = G_\sigma^x * I \quad I_y = G_\sigma^y * I$$

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2. Compute products of derivatives at every pixel

$$I_{x2} = I_x.I_x \quad I_{y2} = I_y.I_y \quad I_{xy} = I_x.I_y$$

3. Compute the sums of the products of derivatives at each pixel

$$S_{x2} = G_{\sigma'} * I_{x2} \quad S_{y2} = G_{\sigma'} * I_{y2} \quad S_{xy} = G_{\sigma'} * I_{xy}$$

4. Define at each pixel (x, y) the matrix

$$H(x,y) = \begin{bmatrix} S_{x2}(x,y) & S_{xy}(x,y) \\ S_{xy}(x,y) & S_{y2}(x,y) \end{bmatrix}$$

5. Compute the response of the detector at each pixel

$$R = Det(H) - k(Trace(H))^2$$

6. Threshold on value of R. Compute non max suppression.

SIFT ALGORITHM TO FIND THE CORRESPONDENCE:

Scale invariant feature transformation (SIFT) algorithm is used to detect an describe local features and images. The feature description of the object is used to extract the interesting points of an object in an image. When an object is attempting to locate in a test image containing many other objects, the description extracted from the training image is used to identify that object. Even under the conditions such as scale, noise and illumination the feature extracted from the training image must have the capability to detectable.
There are 6 steps in this algorithm:

1. **Scale space peak selection:**

   The images are searched for local extrema over scale and space. For example, one pixel in an image is compared with its 8 neighbors as well as 9 pixels in next scale and 9 pixels in previous scales.

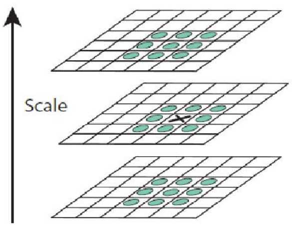

Figure 2: Maxima and minima of the difference-of-Gaussian images are detected by comparing a pixel (marked with X) to its 26 neighbors in 3x3 regions at the current and adjacent scales (marked with circles).

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If it is a local extrema, it is a potential key point (key point represented best in that scale).The difference of Gaussian using two scales is given by

$$G(x,y,\sigma) = \frac{1}{2\pi\sigma^2} e^{-(x^2+y^2)/2\sigma^2}$$

$$L(x,y,\sigma) = G(x,y,\sigma) * I(x,y)$$

$$\begin{aligned} D(x,y,\sigma) &= (G(x,y,k\sigma) - G(x,y,\sigma)) * I(x,y) \\ &= L(x,y,k\sigma) - L(x,y,\sigma). \end{aligned}$$

2. Key point localization:

To get more accurate results the potential key points are refined. To get the location of the local extrema, we use Taylor series. If the intensity at this extrema is less than a threshold value, then key point is rejected. This threshold is called contrast threshold. DoG has higher response for edges. So edges having higher response must be removed. Hessian matrix is used to compute the principal curvatures.

$$\mathbf{H} = \begin{bmatrix} D_{xx} & D_{xy} \\ D_{xy} & D_{yy} \end{bmatrix}$$

The Eigen values of H give a lot of information about the local structure around the key point. In fact, the Eigen values are the maximal and minimal principal curvatures of the surface D(x, y), i.e. of the DoG function, at that point. If the edge threshold ratio is less than 10 then the key point is discarded.

Fig 3: key point localization of an image

In fig3 left side image indicates the key points are scattered all over the images. The right side image indicate that the key point get exactly localized in the image.

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3. Orientation Assignment:

Orientation is assigned to each key point to achieve invariants to image rotation. A neighbourhood is taken around the key point location depending on the scale, gradient magnitude and direction is calculated in that region. An orientation histogram with 36 bins covering 360 degree is created.

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y)$$

$$m(x, y) = \sqrt{(L(x+1, y) - L(x-1, y))^2 + (L(x, y+1) - L(x, y-1))^2}$$

$$\theta(x, y) = \tan^{-1}((L(x, y+1) - L(x, y-1))/(L(x+1, y) - L(x-1, y)))$$

Assign the dominant orientation as the orientation of the key point. In case of multiple peaks or histogram entries more than 0.8 x peak, create a separate descriptor for each orientation (they will all have the same scale and location. Compute the gradient magnitudes and orientations in a small window around the key point – at the appropriate scale.

4. Key point Descriptor:

Consider a small region around the key point. Divide it into *n* x *n* cells (usually *n*= 2). Each cell is of size 4 x 4.Build a gradient orientation histogram in each cell. Each histogram entry is weighted by the gradient magnitude and a Gaussian weighting function with σ= 0.5 times window width. Sort each gradient orientation histogram bearing in mind the dominant orientation of the key point.

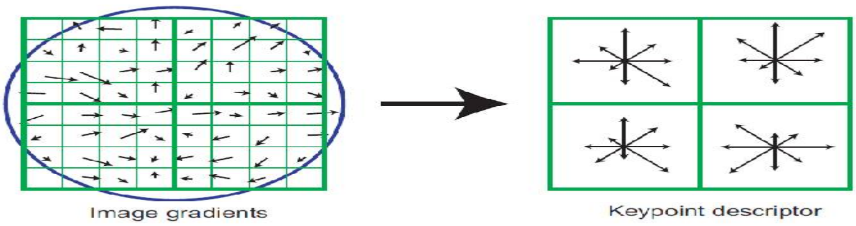

Fig 4: Key point descriptor

In fig 4 the image gradients are built and converted to key point descriptor.

We now have a descriptor of size *r n* 2 if there are *r* bins in the orientation histogram. Typical case used in the SIFT paper: *r* = 8, *n*= 4, so length of each descriptor is 128. The descriptor is invariant to rotations due to the sorting. For scale-invariance, the size of the window should be adjusted as per scale of the key point. Larger scale = larger window. The SIFT descriptor (so far) is not illumination invariant –the histogram entries are weighted by gradient magnitude. Hence the descriptor vector is normalized to unit magnitude.

5. Regularization:

In panoramic stitching it is not needed to enforce the similarity constraints, only perspective correction is necessary. Prefer meshes with local planar assumption that wrap local neighboring regions with similar homographies. This approach achieve better alignment for two wide-baseline images than content preserving warping, the shape of mesh grids is only preserved.

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6. Scale preservation:

Select one image as a reference view in order to avoid the degeneration problem. Only for few images this strategy works well. In order to reduce the alignment error the field-of-view could be increased for the image far from the reference. All the images are equally applied the scale constraint.

IV. PSEUDO CODE

Step 1: Compute x and y derivative of the image.
Step 2: Compute products of derivates at every pixel.
Step 3: Compute the sum of the products of derivatives at each pixel.
Step 4: Define at each pixel (x, y).
Step 5: Compute the response of the detector at each pixel.
Step 6: Compute the threshold value R.
Step 7: End.

V. CONCLUSION

Thus a new image stitching approach has been presented. The mesh based model is more flexible, the moderate deviation could be accommodated in our method from the planar structures. Our method can preserve the local straightness in each image by combining feature alignment, regularization, scale preservation and other extra constraints. Thus composition is improved and achieves good performance on misaligned area. By projection, matching, back projection we are projecting aerial panoramic image according to the degree.

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BIOGRAPHY

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