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# Super Resolution Image Reconstruction using Geometric Registration

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***Abstract*— Super-resolution algorithms are facing a number of issues, in that image registration is one of the major challenges. Here, we need to generate an improved resolution image that is reconstructed based on several geometrically warped, linearly blurred and noisy images. The ultimate goal is to compute a high-resolution image from low resolution image. For this an approach which makes use of geometric registration, feature detection and Contrast invariant feature transformation with affine invariant region descriptors is proposed in this paper. Geometric registration is used to align an improper image in to proper image. Feature detection is used to detect edges and corners of an image. The CIFT stretches image contrast by increasing the intensity value of each pixel to obtain high resolution image. The proposed approach provided a super resolution image with appropriate shape, size and contrast, and increased accuracy and reduced processing time.**

***Keywords*— Super-resolution, Low resolution, High resolution, Geometric registration, Feature detection, Contrast Invariant feature transformation, Affine Invariant Region Descriptors.**

## I. Introduction

Super resolution [1] [2] is a technique to increase the quality of an image using multiple overlapping pictures of a scene and it requires accurate registration of the images, both geometrically and photo-metrically [8]. Super-resolution algorithms face a number of challenges in parallel with their main super resolution task. In addition to being able to compute values for all the super resolution image pixels intensities given the low-resolution image pixel intensities, a super-resolution system must also be able to handle Image Registration, Light variation and Blur identification. Here, in this approach, we give emphasis to all of these tasks. Geometric registration [3] is an important task to align an image. Geometric Registration is concentrated on shape, size and location of an image. It takes an improper image and performs transformations to obtain proper image. Feature detection [4] is used to detect edges and corners of an image to compute high resolution image. Contrast invariant feature transformation (CIFT) [3] is a technique proposed to improve feature detection against contrast changes. The CIFT stretches image contrast by increasing the intensity value of each pixel to obtain high resolution image [5].

The invariant image descriptors [6] play an important role in many computer vision and pattern recognition problems such as image search and retrieval.

## II. Proposed Approach

A block diagram representation of the approach is given Fig.1. The first processing block is the geometric image registration which removes the misallignment and geometrical distortion. The next part is the feature detection for detecting the edges, and corners. The last block improves the contrast using contrast streching function.


Fig. 1 Diagram of the Approach

## III. Image Registration

Geometric registration [4] is an important task to align an image. The steps involved in geometric registration are given in Fig. 2. Edge detection operation is applied on the image so as to detect the edges of an image to make it suitable for Hough transformation and shearing transformation. Output will be the image with lines overlayed, and the aligned/ rotated image.

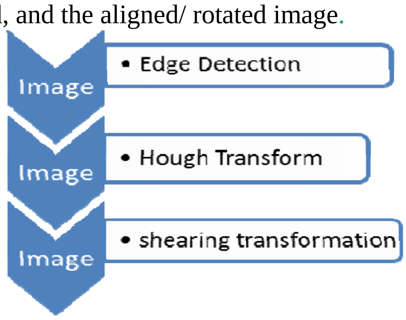


Fig. 2 Steps involved in GR

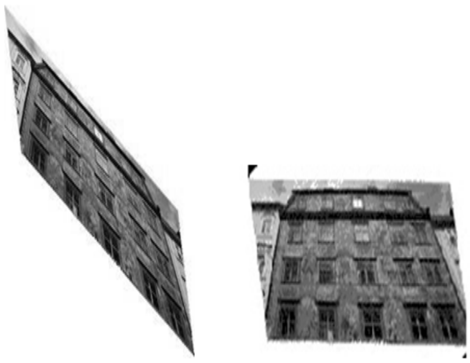

Fig.3 Alignment of an image

Figure.3 shows the input (left) and aligned (right) image by using all the main steps involved in geometric registration.

Feature detection, which includes the detection of the edges as shown in Figure 4 and corners of an image as shown in Figure 5, is given below in Algorithm 1:

**Algorithm 1**

1. Appling the edge detector to the gray level image and obtain a binary edge-map.
2. Extract the edge contours from the edge-map, fill the gaps in the corresponding lines.
3. Compute curvature for each contour to retain all true corners.
4. All of the curvature local maxima are considered as corner candidates, then the rounded corners and false corners due to boundary noise and details were eliminated**.**

The **MatLab function** for the implementing the above algorithm is given below:

**[cout,marked_img]=corner(I,C,T_angle,sig,H,L,Endpoint,Gap_size)**

**Input:**

I - The input image, it could be gray, colour or binary image. If I is empty ([]), input image can be obtained from a open file dialog box.

C - Denotes the minimum ratio of major axis to minor axis of an ellipse, whose vertex could be detected as a corner by proposed detector.

T_ angle - Denotes the maximum obtuse angle that a corner can have when it is detected as a true corner.

Sig - Denotes the standard deviation of the Gaussian filter when computing curvature. H, L - high and low threshold of edge detector.

Endpoint - A flag to control whether add the end points of a curve as corner, 1 means yes and 0 means no. The default value is 1.

Gap size - A parameter use to fill the gaps in the contours, the gap not more than gap size filled in this stage. The default Gap size is 1 pixel.

**Output:**

1. A position pair list of detected corners in the input image.
2. Marked image - image with detected edge marked.

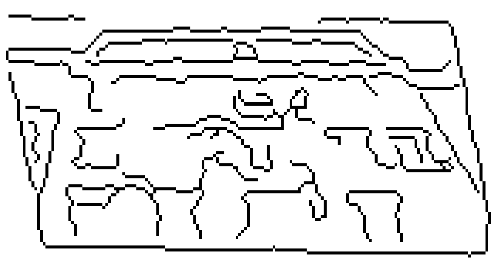

Fig. 4: Edge Detection

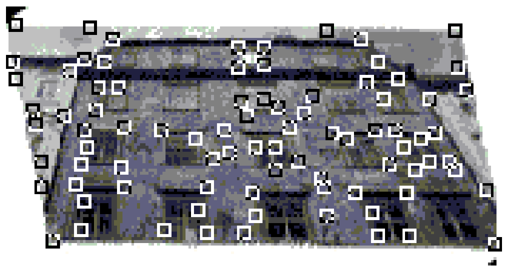

Fig. 5: Corner Detection

**Region descriptors**: Affine invariant region detector belongs to the category of feature detection characteristic points or interest points to make correspondences between images, recognize textures and categorize objects [7]. The affine invariant region detection [6] algorithm consists of a number of steps. The affine invariance is obtained by combining a number of existing algorithms. The location of a region is determined using corner detector algorithms, and the affine deformation of a structure is obtained by using certain properties of the second moment matrix. Because all parameters (scale, location, and shape) influence each other, they all need to be adjusted.

## IV. SUPER RESOLUTION RECONSTRUCTION

Super resolution image reconstruction improves the resolution of an image based on geometrically back-warped, de-blurred and several noisy low resolution images. For geometric distortions corrections, we apply the steps involved in the geometric registration mentioned in Fig.2. Spatial resolution is improved by applying the technique given in [9]. The dynamic range (grey-level resolution) of the image is increased by using contrast stretching discussed below:

**Contrast stretching:** Contrast invariant feature transform (CIFT) is used to improve feature detection against contrast changes and improves the quality of each pixel in an image. The following algorithm (Algorithm 2) performs the task:

**Algorithm 2**

Step1: Assuming an image is an input

Step2: Plot the sigmoid function

```
Index = double([1:cols])/256.0;
transf_funct = 1./(1 + exp(gain*(cutoff-index)));
figure();
plot ( transf_funct, 'r');       % plot the sigmoidal function
```

Step3: After plotting applying a sigmoid function

```
newim = 1./(1 + exp(gain*(cutoff-newim)));   % Apply Sigmoid function.
```

Output: Contrast changed Image. The intensity range of the input image is scaled to 0 to 1. maxans = 1, min ans = 0;

The sigmoid curve used is as shown Fig. 7. The algorithm is tested on image given in Fig. 6. The corresponding contrast adjusted image is as shown in Fig. 8.

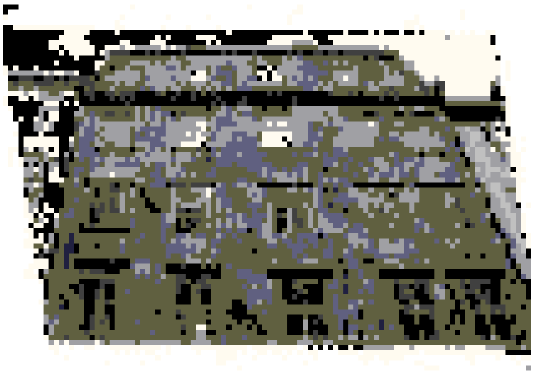

Fig.6 Input Image

Figure 6 is the input image which is aligned and used in this approach to perform contrast stretching technique.

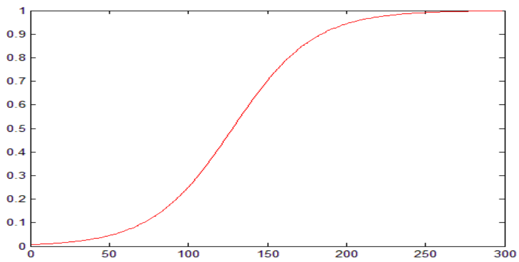


Fig.7 Sigmoid Curve

Sigmoid curve which is naturally in s shape curve, here, it is used to show the improvement of contrast by plotting the curve from the range 0.0070 to 0.9124. Figure 9 indicates the final output image which is aligned and having good contrast.

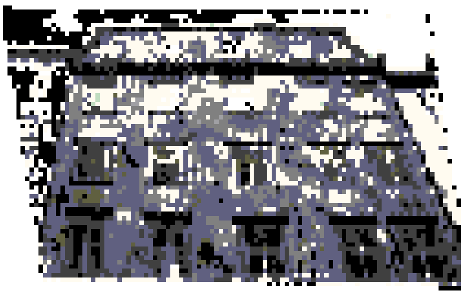

Fig.8 Contrast Adjusted Image

## V EXPERIMENTAL RESULTS

The registration based alignment algorithm is tested, the input and output images of which are given in Fig. 3. The results of edge and corner detection algorithms are shown in Figures 4 and 5. It took 0.797 second for detecting the edges and 0.0478 seconds for detecting corners. The contrast adjusted image obtained with the sigmoid function is given Figure 8.

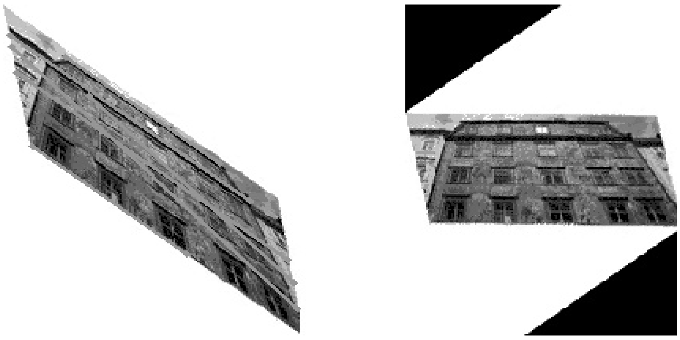

Fig. 9

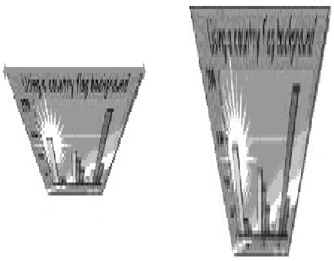

Fig10

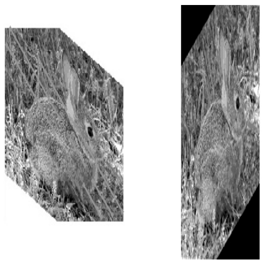

Fig.11

Figures 9 to 13 give input images and the corresponding alligned images of the algorithm on various other images.

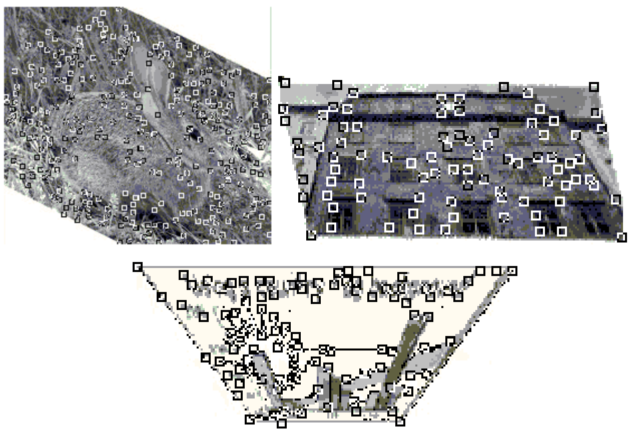

Fig.12

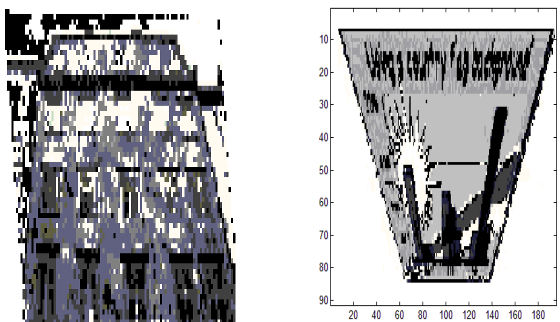

Fig.13

## VI CONCLUSION

This paper presented a new approach, which allows geometric registration of images. Affine invariant region detector belongs to the category of feature detection characteristic points or interest points to make correspondences between images, when the photometric and geometric characteristics of the input images are not identical. These algorithms are used to improve image registration and robustness against illumination changes. The experimental results clearly demonstrated the accuracy of alignment and the increase in the resolution of image.

## REFERENCES


[1] M. Gevrekci and B.K Gunturk. Super resolution approaches for photometrically diverse image sequences. In Acoustics, Speech and Signal Processing, 2007. ICASSP 2007. IEEE International Conference Vol 1, pages 757{760, 2007.

[2] T. madhusudhan and A.R. Pais. Generation of super-resolution video from low resolution video sequences: A novel approach. In Conference on Computational Intelligence and Multimedia Applications, 2007. International Conference Vol 3,2007.

[3] M. Gevrekci and B.K Gunturk. On geometric and photometric registration of images. In Acoustics, Speech and Signal Processing, 2007. ICASSP 2007. IEEE International Conference 1, pages 1261{1264, 2007.

[4] Xingwei Li Ying Zhang Jie Zhang Wanying Xu, Xinsheng Huang and Wei Zhang. An ane invariant interest point and region detector based on gabor lters. In Control Automation Robotics and Vision (ICARCV), 2010 11th International Conference, 2010.

[5] E.E. Armstrong R.C. Hardie, K.J. Barnard, Joint map registration and high-resolution image estimation using a sequence of undersampled images, 6:1621{1633, 1997.

[6] K. Mikolajczyk. Detection of local features invariant to ane transformations. In PhD thesis, Institute National Poly technique de Grenoble, May 2002.

[7] C. Fernandez-Maloigne A. Tremeau M. Gouiffes,C. Collewet. Feature point tracking, Robustness to specular highlights and lighting changes, 2006.

[8] Elad, P., and A. Feuer. "Super-resolution reconstruction of an image." Electrical and Electronics Engineers in Israel, 1996., Nineteenth Convention of. IEEE, 1996.

[9] Lufti Murat Gevrekei; Super resolution and dynamic range enhancement of image sequences, Ph.D Dissertation, Department of electrical and computer science, Louisiana State University, 2009.