Area and Feature Based Image Registration Using Template Matching and SURF Algorithm

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***Abstract*— Image registration plays a vital role in the computer vision. The problems in the computer vision are improved by developing the image processing algorithms. The process of aligning two or more images of the same scene is called the Image Registration. The critical step in image registration is the collection of feature points and evaluate a spatial transformation mainly when outliers are present. In our proposed frame work we have used the feature based and area based methods together. Before applying those methods, the Bilateral Filter is applied for the preprocessing of both the images reference image and the image that needs to be registered so to make the images noise free. For feature detection the SURF (Speeded -Up Robust features) is used which is fast and robust algorithm. KNN (K-nearest neighbors) is used for matching the similar points and for reducing the miss matches the efficient algorithm is used that is Random sample consensus (RANSAC). Template matching method is applied for the area based matching.**

***Keywords*— *Bilateral filter, SURF, KNN, RANSAC, template matching, Image registration*.**

I. INTRODUCTION

In image processing one of the important technique is the image registration. The points of one image aligns with the similar points in another image [11]. We can also say that image registration is the plotting of similarity between two images and those images can be from different sensors, different scenes or taken at different times. It is used in military, medical imaging, the disaster that causes damage that damaged is calculated, it detects the changes. Image registration is also said to be as image fusion.

There are two groups in which image registration is divided.

1) Feature based methods

2) Area based methods.

When there are much features and they can be easily detectable so there features based methods are applied and when there are not more features the methods that are used are the area based methods. Harris corner, edge feature, are common features points [12] and SIFT (Scale invariant feature transform) is also used for the feature based methods. SURF (speeded up robust feature) based registration method is proposed in this research. For rotation invariant and warp transforming SURF is better than SIFT. SURF is three times faster than SIFT because it uses integral image and box filter. For matching of similar points KNN is applied because it is fast method for matching of similar points and RANSAC is used it is robust transformation estimation algorithm or used for reducing the miss matches. For the area based matching template matching method is used that uses the normalized cross correlation technique.

II. RELATED WORK

The SIFT algorithm is used for the detection of features that is invariant to the scale and noise. For matching similar points, the KNN nearest neighbor is used and Random sample consensus method is applied for reducing the miss matching [1]. The SAR (Synthetic aperture radar) and RANSAC algorithm are used to improve the accuracy for the registration of multi modal infrared images [2]. The feature based LLT (locally linear transforming) algorithm has applied for feature matching of remote sensing images. Experiment is done on various other algorithms and LLT has the best precision and recall overall. Its computation time is high [3]. SIFT (MS-SIFT) is new method that define the mode scale and rotation modifications for the features points. Removing the outliers can give the better results [5]. In this author has used the normalized cross correlation for gaining the tie points and that is having the improved spatial distribution after the SIFT registrations [6]. The author has used the area based methods for the first time to registered the images [7]. The author has provided the survey based on the different feature based image registration methods that were explored by the previous researchers [8]. The methods like SIFT, Euclidean distance and RANSAC are used for the multi view point image registration and the KNN was used by the author to improve the accuracy [9]. The survey is provided on the area based matching methods the various papers with different methods are given in the paper [10]**.** The new image registration technique is proposed for the remote sensing images which is the combination of both the area and feature based matching. The method used for the extraction of the features is wavelet and normalized cross correlation matching are applied [11]. The author has used the SURF algorithm so to increase the matching points and

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for the proper image registration. The nearest neighbor algorithm is used for matching the key points [12]. The template matching algorithm (fast affine) is used by the author because affine transformation reduces the Sum of absolute difference error measure [13].

III. PROPOSED FRAMEWORK

The steps that are involved in our proposed framework are shown below in figure.

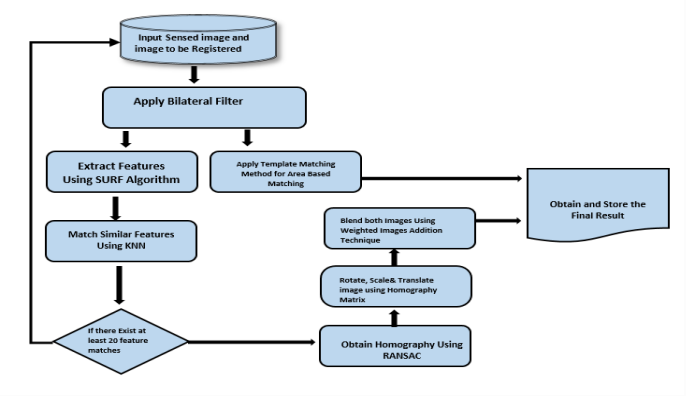

Fig.1. *Proposed Methodology*

Brief description

In image registration two or more images are align and registered. In our proposed frame work the aerial images are used. The first step is to apply the Bilateral filter for the removing of noise because this filter removes the noise while preserve the edges. After that the feature based algorithm SURF (Speeded up robust features) is applied for the feature detection. For the area based matching the template matching method is used so to match the template. KNN is used in our proposed frame work for the matching of the similar points because that is more accurate and for reducing the miss matches the very effective algorithm is applied that is RANSAC (random sample consensus) method. Finally, the images are registered.

A. Feature extractions

In our proposed framework we have used the SURF algorithm. It is the most accurate, fast algorithm for the feature detection in image processing. It is the robust algorithm for local, similarity invariant representation and images comparison. The interest points of the images are defined as the salient features from the scale invariant representation. The next step involves in building orientation invariant descriptors. Surf algorithm is fast in computation of operators because it uses the box filter approach.

B. Feature matching

The feature points are taken from both the images and FLANN (fast algorithm for nearest neighbor) will be used for matching them. FLANN will be used for feature matching. Two values of neighbor at a time will be used. Condition is provided for picking the closest neighbor and Only 0.75 (this ratio is given in the Lowe's research paper) [12]. For both images if it is 75% closest then it will be picked as good match otherwise that neighbor will be skipped. All the features extracted are processed and then analyzed is made whether the matched features are equal or above to the 0.75% threshold (minimum threshold). When the required matching condition is achieved that is at least 50 matches then image is set for the registration else it will be rejected for the registration.

C. Homograph calculation

Registration of the images is the last step and for that we need to calculate the homographic relation between two image which is said to homograph calculation. This is essential and need to done with minimum error so to acquire the image registration with the highest accuracy. RANSAC (Random Sample Consensus) is used in this step. For predicting the best relation between two sets of data this algorithm is applied in our proposed frame work. It will also select the greatest possible values of the rotation, scale or translation of one image with the matched feature points of another image and calculate the homograph using this algorithm and the RANSAC threshold value that we have used is 5.0 its acceptable. The RANSAC will provide the transformation homograph matrix and at last the needed parameters has been accomplished image will be transformed into the fused image.

D. Template matching

For the area based matching in our proposed frame work we have used the template matching method that uses the normalized cross correlation. Finding the areas of an image that matches in the other image or to the template image. In one image we expect to find the match and the patch image will be compared to the template image. A rectangular around will be drawn where the area or template matches.

E. Image Warping

For the implementation of transformation image warping technique is used. To transform the image that need to be registered Affine transform is used. To perform mathematical calculations on pixels like addition of matrix, inverse etc. So to transform every pixel correspondingly.

F. Addition of Images

The process is used to view the final result as compared to the input image. Weighted addition technique is applied that uses the alpha and beta values as transparency for both the images original and resultant image so that the final blended result should be compared in a single image that shows whether the result is accurate or not this is just for the viewing purpose.

IV. EXPERIMENTAL RESULTS

The proposed techniques /methods are tested and applied on the aerial images and have gathered the results with good accuracy. The experiments were conducted on the 20 high resolution images.

A. Image Set

The image 1 is the original image and image 2 need to be registered. The first step is to apply the bilateral filter for the preprocessing of the images and all other methods will be applied on the preprocessed images.

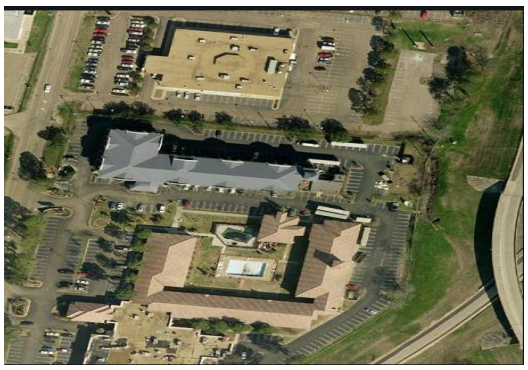

Fig.2. *Image 1 original input image*

Fig.3. *Image 2 image to be registered*

B. Feature Extraction

After getting the preprocessed images now features are extracted using the SURF (Speeded up robust features) algorithm because it is the robust algorithm and fast in computation.

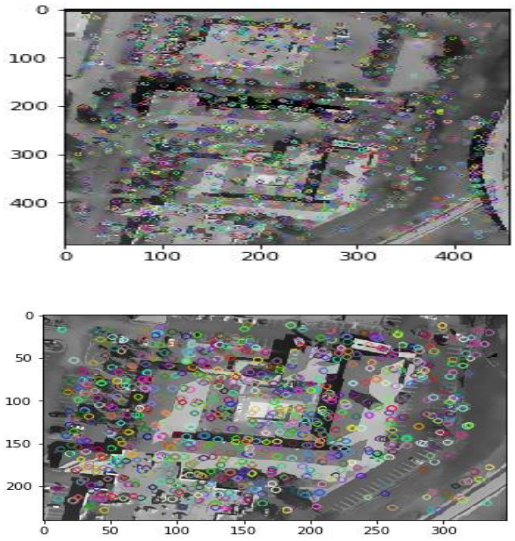

Fig.4. *Features are extracted*

C. Feature Matching

In the previous step features were extracted from the both images now the features are matched between both the images.

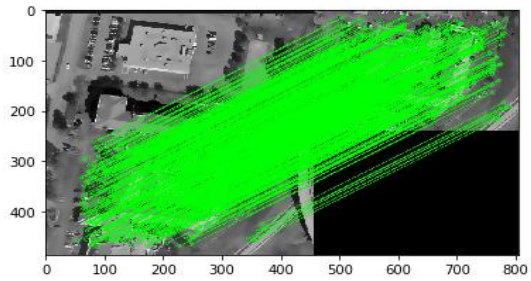

Fig.5. *Feature Matching*

D. Image Alignment

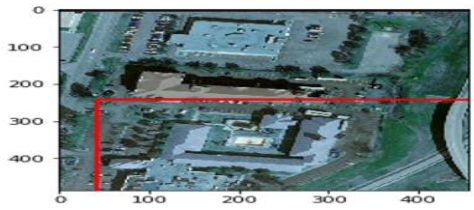

Fig.6. *Image alignment*

E. Template matching

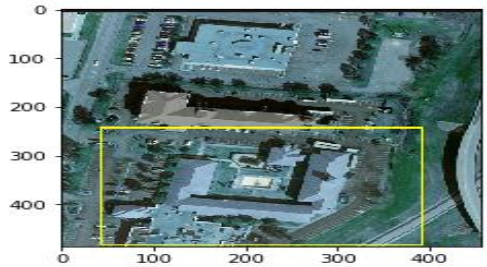

Fig.7. *Template matching*

Fig.8. *Final fused image (Result-1)*

Fig.9. *Input images*

Fig.10. *Final fused image (Result- 2)*

Fig.11. *Input images*

Fig.12. *Final Fused image(Result-3*

TABLE 1. Results of SURF Algorithm

Surf algorithm						
S.no	**Image size**	**Rotation angle**	**T_x pixels**	**T_y pixels**	**No:of matches**	**No:of correct matches**
Result-1	457 × 487 348 × 240	0.04	-43.0979	-243.0991	1946	575
Result-2	427 × 430 356 × 264	0.01	-68.6300	-158.7644	1804	685
Result-3	818× 322 322 × 818	89.8	371.3394	-384.3692	2304	323

TABLE 2: FEATURE DETECTION AND MATCHING USING SURF AND SIFT

		Surf			**Sift**		
S.no	**Image size**	**No:of matches**	**No:of good matches**	**Total time(in seconds)**	**No:of matches**	**No:of good matches**	**Total time(in seconds)**
Result-1	457 × 487 348 × 240	1946	575	2.03s	1371	492	4.6s
Result-2	427 × 430 356 × 264	1804	685	1.77s	1424	571	4.78s
Result-3	818× 322 322 × 818	2304	323	1.8s	1514	314	5.4s

TABLE 3: COMPARISON OF SIFT AND SURF

Algorithm	Rotation	Scale	Blur	Illumination	Time cost
SIFT	good	better	good	good	good
SURF	better	good	better	good	better

V. CONCLUSION

It is concluded from the results that the SURF (Speeded up robust features) algorithm used in our proposed frame work is faster in computation and it is better in rotation invariant, blur and warp transformation than the SIFT.

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