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Detecting image similarity using SIFT.

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Detecting image similarity using SIFT

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Abstract: Manually Identifying Similarity between any images is a bit difficult task, so we have come up with an Image Similarity Detection model which will identify the similarities between two images. The Scale Invariant Feature Transform (SIFT) algorithm is used to detect similarity between input images and also to calculate the similarity score up to which extent the images are matched. SIFT detects the keypoints and compute its descriptors. We will find the best matches of the descriptors by using FLANN Based algorithm. It takes the descriptor of first image and compares with second image. The accuracy point which we achieved in translational images similarity is 60% and in rotational images similarity is 90% and feature matching similarity differ depending upon the given inputs.

Keywords: SIFT, Keypoints, Descriptors, FLANN, Matching, Similarity.

1. Introduction

Image matching plays an important role in the field of computer vision. This is used to recognize an object and to retrieve an image [1]. In recent years, with thorough research on the concept of artificial intelligence and computer vision , implementation of precise and real time image match has turn out to be intense research topic[2].At present, there are many algorithms for detecting the features namely SIFT, SURF, ORB and BRISK etc., [3].

Among those algorithms SIFT algorithm is one of the best approach and it provides best results. Professor David Lowe proposed this SIFT algorithm. The strong traits of the SIFT algorithm is to prevent transformations of the image for matching the keypoints [4]. It selects the potential keypoints by eliminating the keypoints that have low contrast and high edge response. Then it computes the keypoint descriptors which are required to match the features. Image descriptors are widely used in computer vision applications such as image matching, image classification and image retrieval [5]. The usual SIFT descriptor uses orientation histogram to point out the shape of the specific region [6].

The matcher that is used with SIFT in this approach is FLANN based matcher. FLANN is a collection of many optimized algorithm that helps to search the fast nearest neighbor. It finds the first two best matches of the keypoints to compute their ratio and works fast for large datasets.

2. Related work

Based on Feature Detection there are many algorithms namely Scale Invariant Feature Transform (SIFT), Speeded up Robust Features (SURF), Binary Robust Independent Elementary Features (BRIEF), Oriented FAST and Rotated BRIEF (ORB). Comparing with those algorithms SIFT provides best results to match the images. SIFT feature detector when combined with its descriptor will give better results compared to others. Although ORB is faster than SIFT but SIFT gives accurate results. So, we implement SIFT algorithm to find image similarities.

3. Procedure

3.1 Pixel Difference: Pixel difference is helpful to check whether the given input images are equal or not. Suppose the pixel value of a First image at a certain position is 255 and the pixel value of the second image at a corresponding position is also 255.Then difference between these pixel values is 0. Generally, a colored image contains three channels namely Red, Green, Blue. Pixel difference is to be performed on each channel. If each channel gives 0 then we can say that both images are equal otherwise not equal. In the below Fig.1 there is basic working procedure of the image similarity detection. From this we can identify the process where the similarities of the image can be matched.

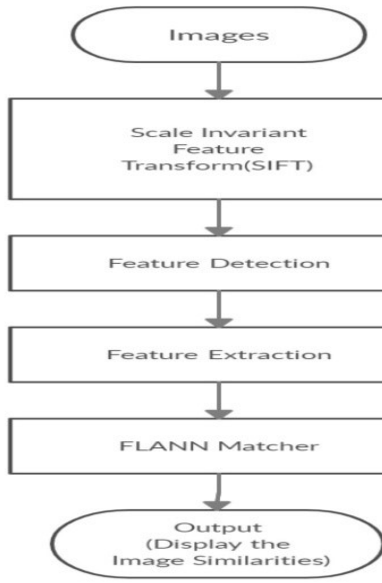

Fig.1: Block Diagram for the Image Similarity Detection

4 SIFT Algorithm

The scale-invariant feature transform (SIFT) algorithm is one of the feature detection algorithm which detects and describes the local features that are present in the images. It detects the keypoints and computes its descriptors present in an image.

4.1 Extrema Detection

In order to detect the local extrema images are supposed to search around scale and space. To find this, every pixel is compared with its neighbouring pixels. The word neighbour includes the pixels that present in surroundings and nine pixels of the previous and next scale. This means to find the local extrema every pixel value is to be compared with 26 other pixel values. If it is a local extrema then we can say that it is a potential keypoint.

4.2 Keypoint Selection

A final check on these keypoints is required to select the most accurate keypoints. After performing the contrast edge test, we are supposed to eliminate the keypoints that having very low contrast. From the remaining keypoints eliminate the keypoints that are very close to the edge and contains high edge response. The keypoints that are selected after the elimination are considered as accurate keypoints.

4.3 Keypoint Descriptors

To create the descriptor from those accurate keypoints, a 16x16 block which is present in the neighbourhood of a certain keypoint is taken. This 16x16 block is separated into 4x4 sub-blocks. For each one of these 16 sub-blocks of size 4x4, orientation histogram of 8 bin is to be generated. So we have 128 bin values in total for each and every keypoint and these are represented in the form of a vector to get the keypoint descriptor.

4.4 Keypoint Matching

For keypoint matching, we used Flann based matcher to match similar features present between the images based on their keypoints.

4.4.1 FLANN Based Matcher

Fast Library for Approximate Nearest Neighbours(FLANN) is used to search the fast nearest neighbour and identify the features of high dimension. FLANN Matcher is the best algorithm for large datasets. The matcher tries to find the first two best matches of the keypoints. Then compute the ratio of the first closest distance to the second closest distance. If the ratio is less than the threshold value then we consider them as good points otherwise those points are rejected.The matches of these good points are drawn and similarity score is calculated with the help of the good points.

Similarity score = (Length of the good points / number of keypoints)*100

In the below Fig.2 the detailed workflow of the Image Similarity Detection is explained. This workflow shows how SIFT and FLANN algorithms are helpful in order to find the similarity matches and similarity score.

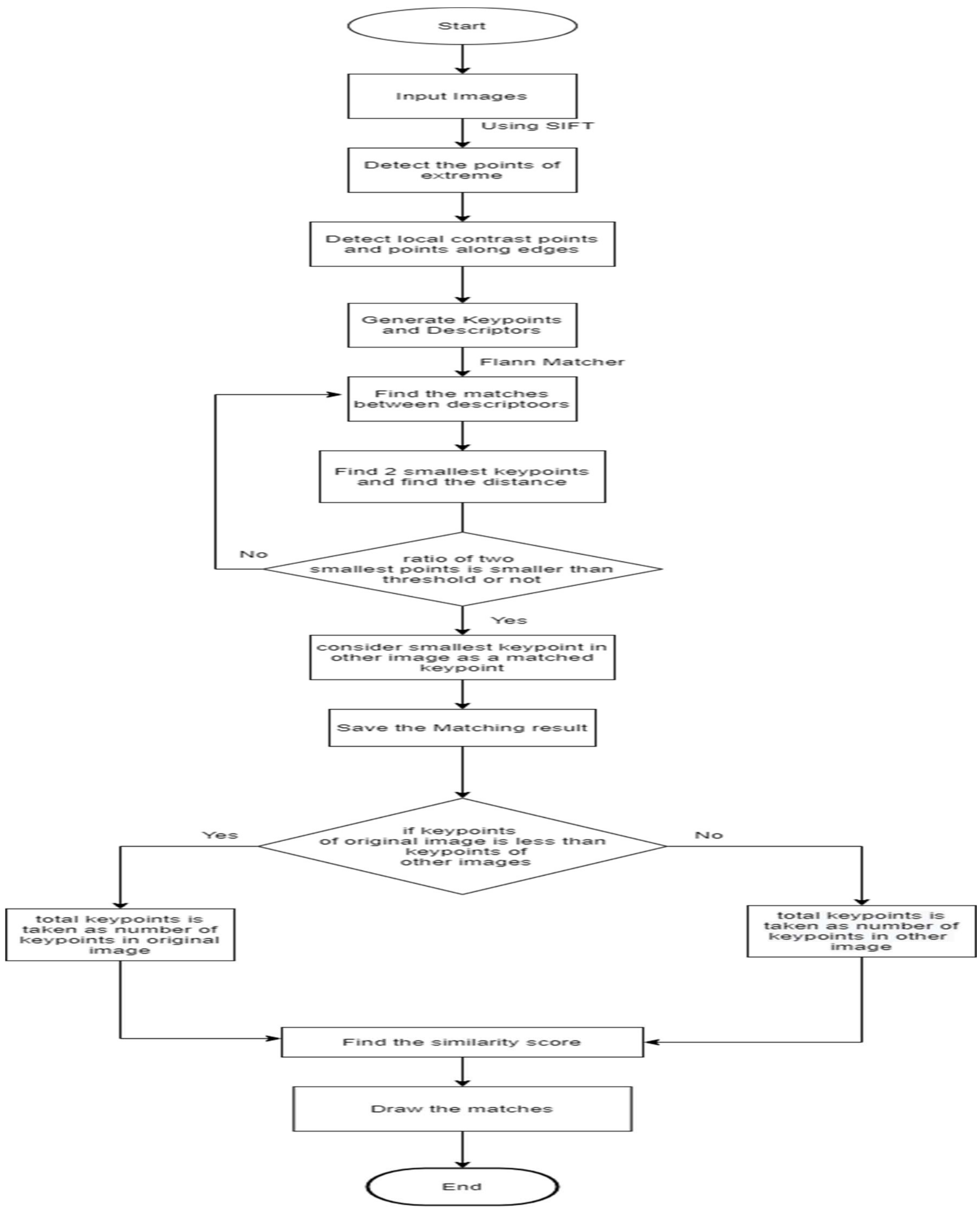

Fig.2: Flow Chart for Image Similarity Detection

5. Pseudocode

Step1: Start

Step 2: Give images as input in which first image must be regarded as original image while second image is to compare with original image.

Step 3: Check whether the input images are equal or not.

If the pixel difference between the two images is 0 then both images are equal.

Else the images are not equal.

Step4: By using SIFT algorithm detect the points of extrema, the local contrast points and points along edges.

Step5: Generate the keypoints and descriptors of the input images.

Step6: Use Flann Based Matcher to find the matches between the images and store all the possible matches of the descriptors in an array.

Step7: Assume the threshold value from which the quality of matches is decided.

Step8: Find the two smallest points by calculating the distance.

Step9: Check whether the ratio of two smallest points is less than threshold or not.

If the ratio is smaller consider the smallest keypoint in other image as a matched keypoint called as good point.

Else repeat the steps 6,7,8,9 until all the keypoints in the images are matched.

Step10: Store the matches identified.

Step11: Find the similarity score by the help of good points.

Step12: Draw all identified good matches.

Step13: End

6. Results

To find the similarities we performed some experiment with the help of SIFT and FLANN algorithms. This was done in python language. We used opencv as it is widely used in detecting images. We take images as an input from various sources to perform the experiment. In the below Fig.3-20 the obtained outputs are from the respective input images. These outputs include similarity matches and the similarity score.

1. Input Images:

Here, two input images are taken as shown in the Fig.3 and Fig.4. By using SIFT algorithm the keypoints of two input images are detected and extracted, also it will find the number of good matches. Those good matches are drawn using FLANN based matcher as shown in Fig.5. The number of keypoints and good matches for the given input images are tabulated in the given table.1.

Fig.3: input image 1

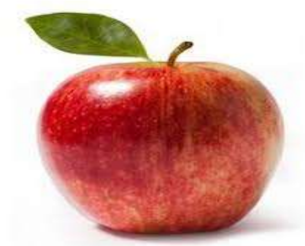

Fig.4: input image 2

Output Image:

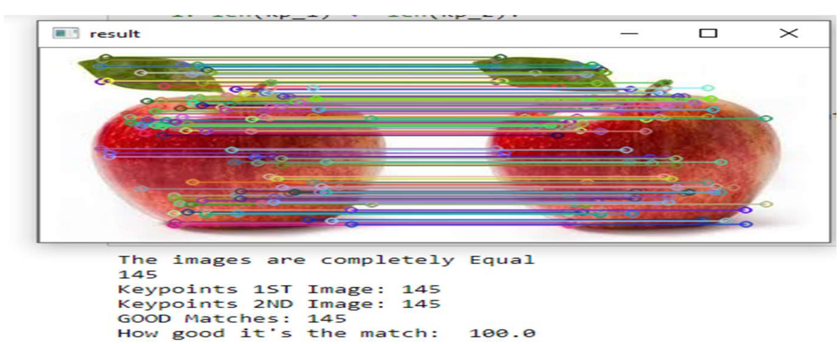

Fig.5: Good matches between apples and similarity score.

Table.1: Similarity Matches for input 1

Image 1 Keypoints	Image 2 Keypoints	Good matches	Similarity score
145	145	145	100

2. Input Images:

Here, two input images are taken as shown in the Fig.6 and Fig.7. By using SIFT algorithm the keypoints of two input images are detected and extracted, also it will find the number of good matches. Those good matches are drawn using FLANN based matcher as shown in Fig.8. The number of keypoints and good matches for the given input images are tabulated in the given table.2.

Fig.6: input image1

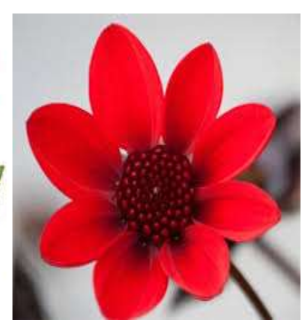

Fig.7:input image2

Output Image:

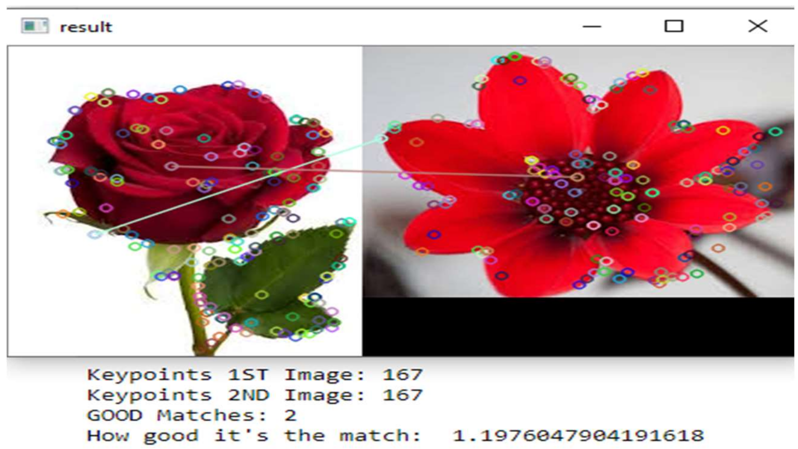

Fig.8: Good matches between flowers and similarity score

Table.2: Similarity Matches for input 2

Image 1 Keypoints	Image 2 Keypoints	Good Matches	Similarity score
167	167	2	1.197

3. Input Images:

Here, two input images are taken as shown in the Fig.9 and Fig.10. By using SIFT algorithm the keypoints of two input images are detected and extracted, also it will find the number of good matches. Those good matches are drawn using FLANN based matcher as shown in Fig.11. The number of keypoints and good matches for the given input images are tabulated in the given table.3.

Fig.9: input image1

Fig.10: input image2

Output Image:

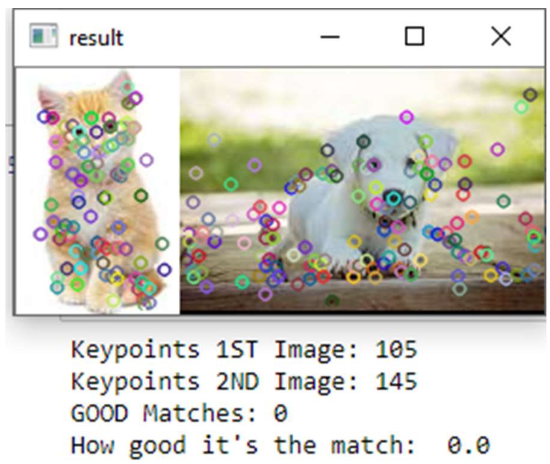

Fig.11: Good matches between images and similarity score

Table.3: Similarity Matches for input 3

Image 1 Keypoints	Image 2 Keypoints	Good Matches	Similarity score
105	145	0	0.0

4. Input Images:

Here, two input images are taken as shown in the Fig.12 and Fig.13. By using SIFT algorithm the keypoints of two input images are detected and extracted, also it will find the number of good matches. Those good matches are drawn using FLANN based matcher as shown in Fig.14. The number of keypoints and good matches for the given input images are tabulated in the given table.4.

Fig.15: input image1

Fig.16: input image2

Output Image:


```
Keypoints 1ST Image: 429
Keypoints 2ND Image: 486
GOOD Matches: 282
How good it's the match:  65.73426573426573
```

Fig.17: Good matches and similarity score for translation of images

Table.4: Similarity Matches for input 4

Image 1 Keypoints	Image 2 Keypoints	Good Matches	Similarity score
429	486	282	65.734

5.Input Images:

Here, two input images are taken as shown in the Fig.15 and Fig.16. By using SIFT algorithm the keypoints of two input images are detected and extracted, also it will find the number of good matches. Those good matches are drawn using FLANN based matcher as shown in Fig.17. The number of keypoints and good matches for the given input images are tabulated in the given table.5.

Fig.18: input image1

Fig.19: input image2

Output Image:

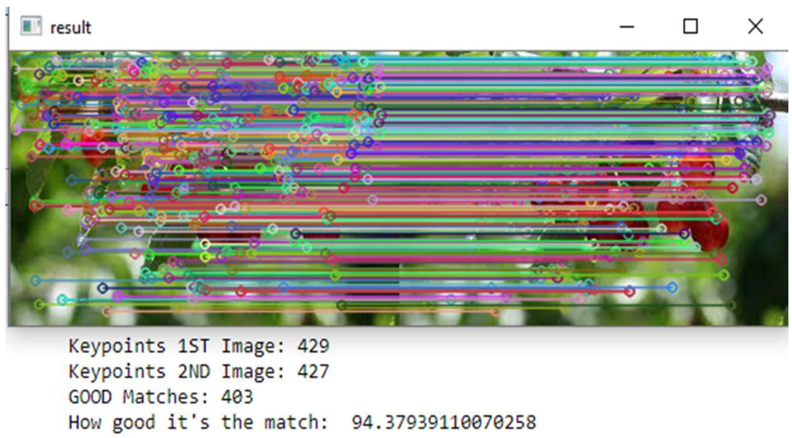

Fig.20: Good matches and similarity score for rotation of images

Table.5: Similarity Matches for input 5

Image 1 Keypoints	Image 2 Keypoints	Good Matches	Similarity score
429	427	403	94.379

Table.6: ACCURACY

Image Transformation	SIFT
Translation	65.7%
Rotation	94.3%

6. Conclusion

SIFT algorithm actually detects the keypoints and compute its descriptors. There are many other algorithms for feature matching but SIFT algorithm has good invariance to image translation and image rotation. FLANN based matching algorithm contains a collection of optimized algorithms for the search of fast nearest neighbour and it works faster than other matching algorithms for large datasets. However sift algorithm complexity is very high and sometimes it gives false matching points while matching. In Future this work can be extended to eliminate the duplicate images.

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