IMPLEMENTATION OF HIGH PERFORMANCE FEATURE EXTRACTION METHOD USING ORIENTED FAST AND ROTATED BRIEF ALGORITHM

Prashant Aglave[1], Vijaykumar.S. Kolkure[2]

[1]M.E (Electronics, Appeared), Department Of Electronics Engineering, Bharatratna Indira Gandhi College of Engineering, Affiliated to Solapur University, Solapur, Maharashtra, India.
[2]Assistant Professor, Department Of Electronics Engineering, Bharatratna Indira Gandhi College of Engineering, Affiliated to Solapur University, Solapur, Maharashtra, India.

Abstract

Feature-based image matching is an important characteristic in many computer based applications such as object recognition, 3D stereo reconstruction, structure-from-motion and images stitching. These applications require a lot real-time performance. Feature based algorithms are well-suited for such operations. Different algorithms are used for image processing like Scale-invariant feature transform (SIFT), Speeded up Robust Features (SURF), Oriented FAST and Rotated BRIEF (ORB). ORB is one of the fast binary descriptor which is relying on BRIEF, where the BRIEF is rotation invariant and resistant to noise. This paper gives the advantages of rotation invariance and scale invariance of ORB algorithm for object detection technique. Query based object detection method is explained in this paper for object detection with efficient computation time. Different experimental results prove the scale invariance and rotation in variance of ORB in query based object detection method.

***Keywords:** ORB, BRIEF, SIFT, SURF*

--***--

1. INTRODUCTION

Now days many industrial applications require object recognition and tracking capabilities. Many feature-based algorithms are well-suited for such operations. Recent industrial applications needs object recognition and tracking capabilities. Object recognition technology has matured to a point at which exciting applications are becoming possible. Oriented FAST and Rotated BRIEF (ORB) is a very fast binary descriptor which is relying on BRIEF. Where BRIEF is rotation invariant and resistant to noise. ORB is a two order of magnitude faster than Scale-invariant feature transform (SIFT), it can be verified through experiments while performing as well in many situations.

ORB uses the known FAST keypoint detector and the BRIEF descriptor, that why we call it as ORB (Oriented FAST and Rotated BRIEF). Both Fast keypoint detector and BRIEF descriptor are attractive because of they have better performance and low cost. The recognize method for object recognition is Scale invariant feature transform (SIFT), which is popular for its invariance to scaling, rotation and illumination, is computationally difficult due to its weighty workload required in local feature extraction and matching operation. Thus computer vision kind of applications demands high performance and low complexity solution and ORB provides better solution to it.

2. GENERALIZED BLOCK DIAGRAM

ORB is basically a fusion of FAST keypoint detector and BRIEF descriptor with many modifications to enhance the performance. First it uses FAST to find keypoints, and then apply Harris corner measure to find top N points among them. It also use pyramid to produce multiscale-features.

ORB is rotation invariant and resistant to noise. Another advantage of ORB is its very low memory requirement. Its descriptor provides comparable precision/recall results with SURF and SIFT.

Following figure explains the methodology to be used in proposed system. The proposed system can be divided into following steps:
1) Conversion of image to text files using MATLAB.
2) Applying ORB algorithm to the image.
3) Conversion of text files to image in MATLAB.
4) Displaying the output image.

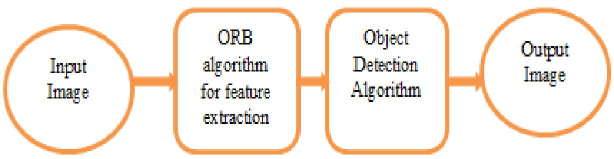


Fig 2.1 Generalized Block Diagram

For object detection we require two input images: Trained image and query image. ORB algorithm is then applied on each image to extract the interest points in each image. Fig 2.1shows the generalized block diagram of object detection using ORB. After extracting the features of both images, they are matched to detect object in the query image.

3. FLOW OF PROPOSED WORK

Proposed work can be divided into two main parts first one the Simulation flow and second one is its implementations. In this proposed work we will take the input images both simple image and rotated image, then we will find the corner points in both simple and rotated images using ORB detector. After that we describe the features in binary form using ORB descriptor and find all the matches in both simple and rotated images. Out of all the matches sort out the good matches, then we will draw the match and show the result. After that repeat this procedure with different rotation angles in second image.

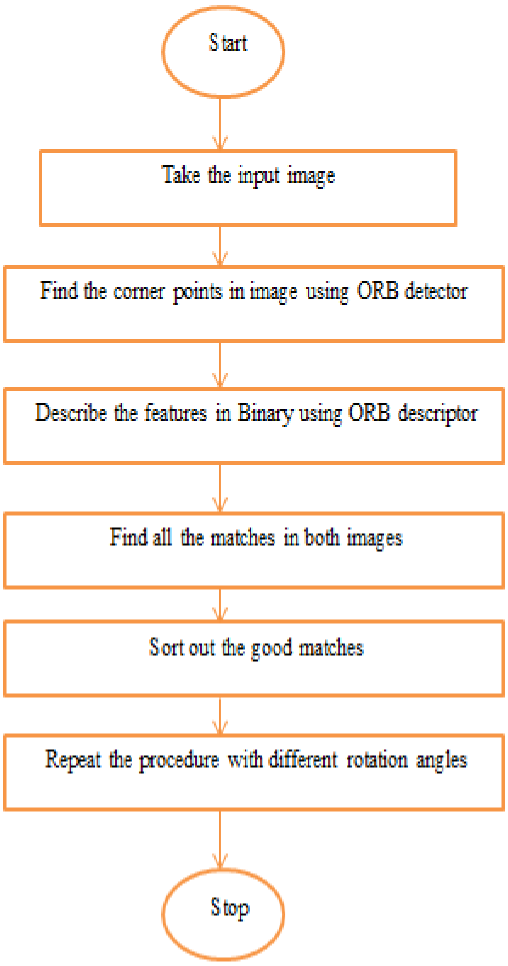


Fig 3.1 Simulation Flow of proposed work

3.1 Feature Matching Algorithm

Feature matching algorithm includes following steps:
1. Take both simple and rotated input images-
In this step feature matching simple and rotated image is taken.
2. Calculate the features of both the images-
ORB uses FAST detector to detect features from images. FAST keypoint detector takes an input and calculates the corner points of the image. Cornet points have the property that, there exists a set of `n' contiguous pixels in the circle (of 16 pixels) which are all brighter than Intensity of pixel point added with threshold, or all darker than intensity of pixel subtracted by threshold. Function for comparing intensity values is given as:

$$f(x) = \begin{cases} -d, & Ip \rightarrow x \leq Ip - t \\ b, & Ip + t \leq Ip \rightarrow x \end{cases}$$

3. Find out the binary descriptors for the features in the images. [12]
(a) In a 31x31 area round an interest point.
(b) Randomly create 256 9x9 pairs patches, call them Ai, Bi.
(c) For each pair, if, then set the corresponding bit to 1, else 0.
(d) The resulting 256 bit vector is the descriptor for the patch.
4. Match both the descriptors vectors-
The Hamming distance between two strings of equal length is the number of positions at which the corresponding symbols are different. In other way, it measures the minimum number of substitutions required to change one string into the other, or the minimum number of errors that could have transformed one string into the other.
Eg. The Hamming distance between 1011101 and 1001001 is 2.
5. Find out the common points in the image-
If the images are same then find out the common points.
6. Find the good matches.
Select the strongest keypoints depending upon the distance. Find the homography between the two kepoints, which will give good matches.
7. Plot the matched good keypoints in the images.
Finally plot the good keypoints in the images.

4. OBJECT DETECTION

Query based object detection method is explained in figure 4.1. In this method, ORB algorithm is applied to an image. Features described by this image are used to detect whether the object in this image is present in the other image or not. This image is called as ‘Trained Image’. The image in which the object is to be detected is known as ‘Query Image’. After calculating features of both the images using ORB, this method matches the common features in the two images and draws the box around the object if features are matched.

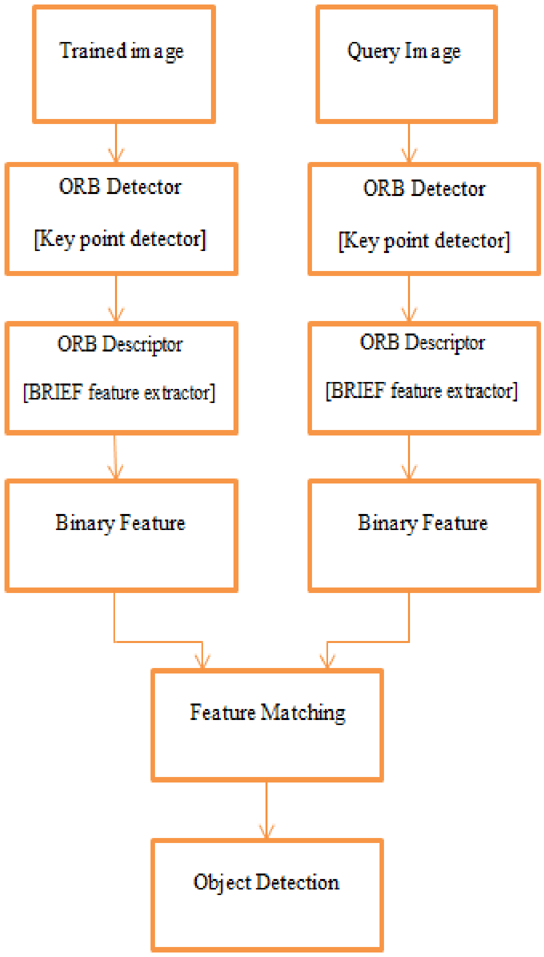


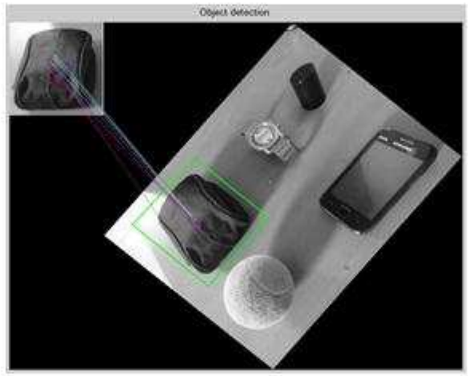
Fig 4.1 Query Based Object Detection Flow Chart

Above flow chart shows query based object detection. Following steps are used to detect an object.
1. To detect the object in an image, we need minimum two images:
(a) Image of the object to be detected (trained image).
(b) Image in which the object is to be detected (Query image).
2. Detect Feature Points using the ORB detector.
3. Extract Feature Descriptors by passing the keypoints (features) as input to the ORB descriptor.
4. Find putative point matches using appropriate matcher.
5. Locate the object in the query image Using Putative Matches.
6. Detect Another Object.

5. RESULTS

a) Trained Image

b) Query Image



c) Object Detection

Fig 5.1 Object detection using ORB

The first image is the trained image and second image is the query image. Here we have to find the trained image in query image. Fig c. shows the object detection using ORB algorithm. We also done the object detection with 'case.png' using different angle rotation and the result are shown below.

Table 5.1 shows rotation invariance in the query based object detection method with image 'case.png'. Computation time required for the object detection is calculated.

Table 5.1: Rotation Invariance Table for 'case' image

SR.No	Image	Rotation (Degrees)	Computation Time(Seconds)
1	Case.png	45	1.259
2	Case.png	50	1.446
3	Case.png	75	1.514
4	Case.png	110	1.372

In table 5.1 change in the computation time is because of the change in size of the query image due to rotation at different angles. Table 5.2 shows scale invariance results in the query based object detection method with image 'case.png'. The algorithm is applied on different sizes of trained image and computation time is calculated for each size of the image.

Table 5.2: Scale invariance Table for 'case' image

SR.No	Image	Image Size	Computation Time(Seconds)
1	Case.png	300x300	1.177
2	Case.png	200x200	1.278
3	Case.png	100x100	1.663
4	Case.png	50x50	1.421

Query based object detection method detects trained image object of different sizes with efficient computation time. Change in the computation time is because of the resizing of the image. Table 5.1 shows rotation invariance in the query based object detection method with image 'case.png'. Computation time required for the object detection is calculated.

6. CONCLUSION

This proposed system will help to extract the features in a given image by using ORB irrespective of the rotation of the image. Features extracted using this algorithm will be further used for classification and detection of the object also for the annotation of the image. ORB implementation consists of fast detector which has fast and accurate orientation component to fast and BRIEF descriptor. ORB is better than SIFT and SURF to find adjacent-neighbor matching over large databases of images. Proposed query based object detection method is tested for different rotations and sizes of the trained image. Experimental results show that this method detects the object for any rotation angle and size of the trained image. Thus, proposed query based object detection method which uses ORB for feature extraction solves the problem of rotation invariance and scale in variance to maximum extent in object detection.

REFERENCES

[1] Ethan Rublee, Vincent Rabaud, Kurt Konolige Gary Bradski, **"**ORB: an efficient alternative to SIFT or SURF"**.**

[2] OndrejMiksik, "Evaluation of Local Detectors and Descriptors for Fast Feature Matching".

[3] Michael B. Holte, Cuong Tran, Mohan M. Trivedi, Thomas B. Moeslund,"Human Pose Estimation and Activity Recognition From Multi-View Videos: Comparative Explorations of Recent Developments".

[4] Herbert Bay, Tinne Tuytelaars, and Luc Van Gool,"SURF: Speeded Up Robust Features".

[5] Yan Ke, Rahul Sukthankar, "PCA-SIFT: A More Distinctive Representation for Local Image Descriptors", International Journal of Conceptions on Electronics and Communication Engineering,Vol. 1, Issue. 1, Dec 2013; ISSN: 2357 2809.

[6] ViniVidyadharan, and SubuSurendran, "Automatic Image Registration using SIFT-NCC", Special Issue of International Journal of Computer Applications (0975 – 8887) , pp.29-32, June 2012.

[7] D. Lowe. "Distinctive Image Features from Scale-Invariant Keypoints", Accepted for publication in the International Journal of Computer Vision, pp. 1-28, 2004.

[8] Edward Rosten and Tom Drummond, "Machine learning for high-speed corner detection", International Conference on Computer Vision,2008.

[9] Edward Rosten and Tom Drummond, "Fusing points and lines for high performance tracking",European Conference on Computer Vision,2006.

[10] Dilip K. Prasad, "Survey of The Problem of Object detection In Real Images",International Journal of Image Processing(IJIP),Volume(6):Issue(6):2012.

[11] Mikolajczyk, K., Schmid, " An affine invariant interest point detector.ECCV.(2002) 128.

[12] S.Winder and M. Brown, "Learning Local Image Descriptors," *in Proc.CVPR'07*, 2007

BIOGRAPHIES

Prashant Aglave[1] has received his B.E. degree from, University of Pune in 2008. He is currently pursuing M.E in Electronics Engineering from B.I.G.C.E, Solapur University.

Vijaykumar S. Kolkure [2] has completed M.E. (Electronics) from W.C. Sangli, Maharashtra, India. He has 10 years of teaching experience. Currently he is working as Assistant Professor at Bharatratna Indira Gandhi College of Engineering, Solapur, Maharashtra, India. His area of interest is Image Processing, Video Processing.