SETSCI Conference Indexing System,
Volume 3 (2018), 179-181

ISAS 2018-Winter
2nd International Symposium on Innovative Approaches in Scientific Studies
November 30 – December 2, 2018, Samsun, Turkey

Object Recognition System Based on Oriented FAST and Rotated BRIEF

Majeed A. Mohsin ABDULMAJEED[1], Levent SEYFİ[2*+]

[1,2]Dept. of Electrical and Electronics Eng. /Konya Technical Universtiy, Konya, Turkey
[*]Corresponding author/[+]Speaker:leventseyfi@selcuk.edu.tr
Presentation/Paper Type: Oral / Full Paper

Abstract – Over the last few years, object recognition systems take the researchers' attention. The revolution in the artificial intelligence and computer vision systems and algorithms drives to numerous approaches. In this research, we are presenting an object recognition system that used ORB (Oriented FAST and Rotated BRIEF) as a feature extraction method, the proposed approach used as a robot system that performs objects detection and recognition tasks. We used ORB to detect preset features in a given video frame obtained from the camera at real-time and then used Brute-force matcher to match a new video frame features with the object image that we want the robot to track it and recognize it. The matched point must have a distance ratio of 0.65.

Keywords – Object recognition, ORB, BRIEF, FAST, RC Robot, Feature matching, Brute-force Computer Vision

I. Introduction

The Tasks of the object recognition in real-world applications possess complicated issues such as illumination, rotation variant, scale variant, and collision areas. These challenges require a features extraction techniques that can't be affected by the clutter in the nearby environment. The challenging problem of the object recognition systems is due in a massive part to the lack of getting such image features successfully. Object recognition is a challenging computer vision task because its an essential part of numerous applications such as image search, image auto-annotation, scene perception, and real-time object tracking.

Recently, many of approaches and advances introduced such as model-based, shape-based and appearance-based methods.

The Techniques that based on a model method represent the object in the image as a set of various three-dimensional objects [1]-[3] such as cones and cubes. The Shape-based techniques [3]-[8] trying to describe the object in the image by its shape primitives like boundary fragments and contours. In the opposite, the appearance-based techniques used only the appearance which is captured by different views of the object in the two-dimensional images. In this research paper, Oriented FAST and Rotated BRIEF algorithm used as a feature extracting method. The algorithm introduced by Ethan Rublee, Vincent Rabaud, Kurt Konolige and Gary R. Bradski in their paper in 2011, as they mentioned it is an excellent alternative to SIFT and SURF in computational cost and matching performance and substantially in the patents where ORB is a free and Open-source algorithm available as a part of OpenCV computer vision library. ORB based on FAST (Features Accelerated from Segment Test) key points detector and BRIEF (binary robust independent elementary features) descriptor with some modifications to improve the performance. The implementation of the ORB algorithm with the Brute force matching method used in our work. The system detects interset key points from the camera video frames at the real-time and matching the descriptor with given reference object image descriptor using Brute-force the distance ratio between detected keypoints must be 0.65 and skip all other key points. We are using a features filtering method to reach a high performance and accuracy in detecting such object in any background scene.

II. Materials and Method

In our paper, we propose an object recognition method that based on Oriented FAST and Rotated BRIEF algorithm besides to Brute-force matcher algorithm. The presented system is an RC robot that can be automated or semi-automated. The robot transmits live video stream over the network, and it processes the video frames, it detects objects by feature matching between the real-time video frame and the reference object image that we want to track it. LattePanda was preferred as a microprocessor in the developed system. It is a computer-on-module powered by Intel atom processor, 4GB RAM and 64GB embedded memory. Figure 1 shows the Lattepanda board.

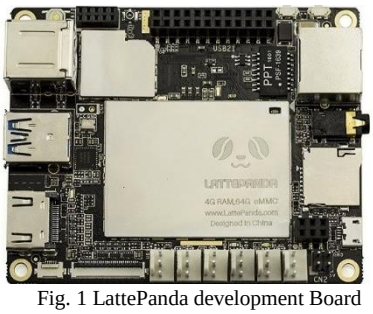


Fig. 1 LattePanda development Board

Zumo robot shield which is shown in Figure 2 was used for moving part of the developed robot. It consists of 4 motors and speed controller. The Lattepanda can control the speed of the motors using the commands that received from the Joystick.



Fig. 2 Zumo robot shield

A4Tech HD webcam which is shown in Figure 3 was used as a camera module on the moving robot. The camera is connected to the lattepanda via USB connection.



Fig. 3 A4Tech webcam

Lattepanda bluetooth keyboard which is shown in Figure 4 was used to remotely control the robot using the arrows. When you click the arrows the robot will move to the selected direction.



Fig. 4 Lattepanda keyboard

Figure 5 shows the RC robot and the Controller. The controller is Bluetooth powered and used to send a command to the robot to move. Figure 6 presents the flowchart of the proposed system. Firstly, the video frame obtained from the camera to detect the features using ORB then matching its features with reference object image using Brute-force matcher and then applying the filtering method to find the best matches. If the matches equal or greater than the threshold value, the object will be recognized.



Fig. 5 The RC robot

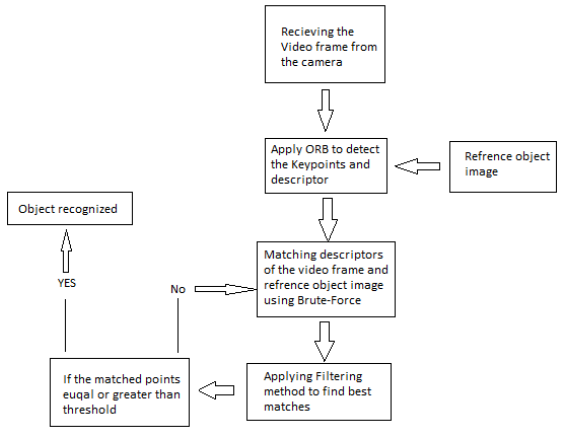


Fig. 6 Flowchart of the proposed system

A. Oriented FAST and Rotated BRIEF algorithm

ORB is a fast, robust local feature detector introduced by Ethan Rublee et al. in 2011, The author of the algorithm made some modifications on the FAST keypoints detector algorithm and BRIEF descriptor to enhance the performance with orientation and rotation. The FAST does not compute the orientation. The authors modify it to calculate the intensity centroid of the patch with a located corner at the center. The direction of the vector from this corner point to centroid gives the orientation. Moments are computed to enhance the rotation invariance. Also, authors of ORB modify the BRIEF descriptor algorithm to perform better with rotation by steering the BRIEF according to key points orientation. Figure 7 Shows the ORB matching performance.

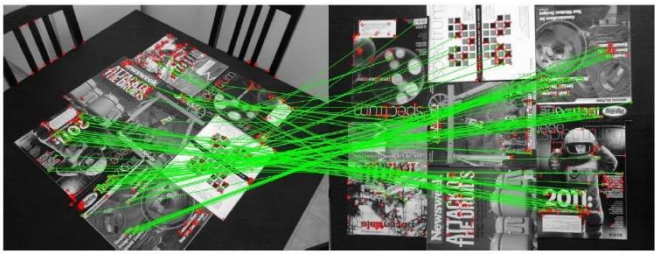


Fig. 7 ORB matching performance

B. Features matching

In our paper, we used the brute-force matcher which is manageable. It uses the descriptor of one feature in the first set and is matched with all other features in another set using some distance estimation. Moreover, the adjacent one is returned. After we extract the matches, we filter them to get the best match possible by measuring the threshold which it is the summation of matches distance divided by the length of them and multiply them by the ratio. The ratio is 0.65. The best matches that have a distance less than the threshold value.

III. RESULTS

We used an RC robot system with Lattepanda computer on module and camera for real-time object tracking and recognition the Robot is wifi powered which is transmit live video to another Computer. Each video frame that obtained from the camera, the algorithm extracts the key points on the image and matching its descriptor with a reference object image descriptor. The matches filtered using distance threshold to get the better matches between the object image

and object in the scene of the camera. Figure 8 shows the performance of our system.

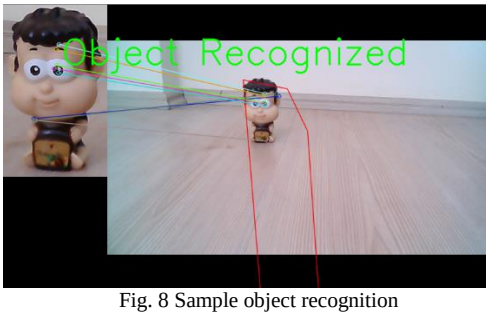


Fig. 8 Sample object recognition

IV. DISCUSSION

The designed robot is subject to furtherly developing, especially in terms of software. After automatically recognition of an object or multiple objects is succeeded, it can be used in a wide area of today's world. In this context, this project is aimed to be more developed in order to work for multiple purposes.

V. CONCLUSION

Object recognition is a relevant computer science field, and it targets many applications such as military, security and facial recognition. Image features extraction methods play a significant rule in the performance of such systems. In this research paper, we presented a method based on Oriented FAST and Rotated BRIEF Features and using brute-force matcher with matches filtering method based on distance threshold.

REFERENCES

[1] M. Bennamoun, and G. Mamic. *Object recognition: fundamentals and case studies*. Springer Science & Business Media, 2002.

[2] P.J. Besl, and R.C. Jain, *Three-dimensional object recognition*, ACM Computing Surveys (CSUR) 17.1 (1985): 75-145.

[3] I. Biederman, Recognition-by-components: A theory of human image understanding. *Psychological Review*, 94(2):115-147, 1987.

[4] A. Opelt, A. Pinz, and A. Zisserman. A Boundary-Fragment Model for Object Detection. *In Proc. ECCV*, volume 2, pp 575–588, May 2006.

[5] B. Wu, and R. Nevatia. Detection of multiple, partially occluded humans in a single image by bayesian combination of edgelet part detectors, *Tenth IEEE International Conference on Computer Vision (ICCV 2005)*, Vol. 1. 2005.

[6] A. Opelt, A. Pinz, A. Zisserman, Incremental Learning of Object Detectors Using a Visual Shape Alphabet, *Proceedings of the 2006 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'06)*.

[7] S. Belongie, J. Malik, And J. Puzicha, 2001. Matching shapes, In Proceedings of the IEEE International Conference on Computer Vision (ICCV'01).

[8] S. Belongie, J. Malik, and J. Puzicha, Shape Matching and Object Recognition Using Shape Contexts, IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 2, no. 4, pp. 509-522, Apr. 2002.

[9] E. Rublee, V. Rabaud, K. Konolige, G. Bradski, ORB: An efficient alternative to SIFT or SURF, *IEEE international conference on Computer Vision (ICCV)*, 2011.