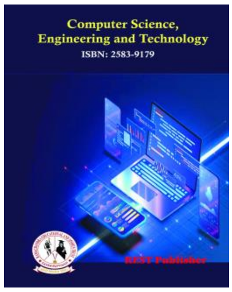
Computer Science, Engineering and Technology

Vol: 2(1), March 2024

REST Publisher; ISSN: 2583-9179 (Online)

Website: https://restpublisher.com/journals/cset/

DOI: https://doi.org/10.46632/cset/2/1/6



Object identification using Interleaved feature extraction model

***[1]Saritha Dasari, [2]A Rama Mohana Reddy, [3]B. Eswara Reddy**

[1]JNTUA, Ananthapuramu, Andhra Pradesh, India.

[2] S.V. University, Tirupati, Andhra Pradesh, India.

[3]JNTU, Kalikiri, Andhra Pradesh, India.

**Corresponding Author Email: sarithadasari123@gmail.com*

Abstract. *Image mining spanning the system of image applications has proved to be of good use in most industrial image processing applications. It supports a large field of applications like medical diagnosis, agriculture, industrial work, space research, and the educational field. Image Mining involves extracting information as well as image detection and extracting the image segment. It is often seen that these steps are considered in isolation leading to completely independent flow of process. This paper overlaps the steps leading of feature extraction and object recognition to provide better results of object identification. The increase in best features' percentage is a novel idea and yields good results of identification. ORB being very fast is used in the first pass and when object is not identified for confirmation we use the SURF to confirm the results. The process of identification can easily be implemented to more than one image in a directory and hence provides better and good recognition. This bulk processing can further be extended to repository of images in the social media hence increasing the scope of the research.*

Keywords: *Image mining, Image feature extraction, bulk processing, social media images, web image mining.*

1. INTRODUCTION

Image Mining is a process of extracting knowledge concerning images. The demand of image mining increases as the need of image data is growing day by day. There are many techniques developed in the earlier researches and eventually these techniques can reveal useful information according to the human requirements, but Image Mining still require more development especially in the area of web images.[8] In present scenario, image plays a vital role in every aspect of business such as business images, satellite images, and medical images and so on.[6] Image mining is challenging field which extends traditional data mining from structured data to unstructured data for image data analysis. With the rapid increase of WWW.websites are an abundant source of information and hence their usage patterns are brought to the book. The task of mining is difficult considering the fact that Web traffic volume is enormous. [15] Data collected is both structured and unstructured requires different analytical techniques. Object being the most important entity, its recognition and recognition technique plays an important role in almost all the applications of image mining [10]. Images being the main focus of recent research have dealt with analysis, object detection and mining algorithms in great detail. [3] It is found that each of these algorithms have their own advantages and disadvantages depending on the data set, quality of image, nature of analysis and the application. Image analysis methods that provide for both detection and feature extraction are Scale Invariant Feature Transform (SIFT), SURF, BRISK and ORB. [12] Descriptor helps in matching features on two images. Brute-force descriptor matcher matches feature of two different images based on distance calculations. This results in return of close pairs of images. [11] As the number of comparisons is more in this method, time consumed is high. The research works on striking a balance time efficiency and quality of matches found. [14] Objectdetectionneedsmatchingoffeaturesintwoimagesofthesameplanarsurfaceinspace. The images are related by holography and removal of outline is a necessary step for accuracy of holography matrix. Such outliners are removed using RANSAC and LMeds algorithms. [3] The main objective of the paper is to provide a frame work that is time efficient and accurate matching in a directory of given images. [7] It is often seen that individual methods have their own disadvantages. This papers uses four detection and extraction methods SIFT, SURF, BRISK and ORB in combination of brute-force method, RANSAC and LMeds algorithm is used for removal of outliners to enhance efficiency. Theframeworkusesspecificsequencetodeducttheobjectandonfailingusesapairof method to quickly confirm or ascertain fault in detection.

2. LITERATURE REVIEW AND DISCUSSION

Feature Extraction: Feature from Accelerated Segment Test(FAST) is based on corner detection. This method can be used for extracting feature points and to map/track objects of interest. The algorithm works on the principal of identifying the corner pixel based on checking the surrounding 16 pixels (Brenham circle with radius 3). The pixels around the candidate pixel under consideration are numbered in clockwise order on the circumference. Then, if there exists N consecutive pixels on the circumference that are brighter, when compared with the sum of the center pixel's brightness and the threshold OR darker than the subtraction of center pixel's brightness and a threshold is considered as the corner pixel. The process is fast enough and reliable. [13]

The process of Scale Invariant Feature Transformation (SIFT) helps in detecting local features. The important concepts are the scale and the orientation. Interesting points are first found on the graph and its descriptors are determined. Shooting angle, brightness and rotation angle have very little or no effect on the procedure. Originally the descriptor used the gradient information of 8 directions, which was calculated in a window of 4X4 in the critical scale space. The dimension vector was 128 dimension. [5]

Speed UP Robust Feature (SURF) helps in detecting and describing local feature points. SURF is understood in three parts; extraction of local features, Description of these local features extracted and Matching of these feature points [1] The improvement was brought about in this method with the use of Hessian matrix (integral graph) and dimension reduction. Using the matrix, pixels are divided into differentsub-regionscalculatedas $\sum dx$ and $\sum dy$, sumoflength is $\sum|dx|$ and$\sum|dy|$. Hence each sub-region has 4 descriptors leading to 64-bit dimension feature generator.

OrientedFASTand Rotates BRIEF (ORB) is a feature extraction and detection procedure. The algorithm provides feature extraction and description of extracted features, here feature extraction uses FAST algorithm and description uses BRIEF (Binary Robust Independent Elementary Feature) [2]. The concept lies in selecting 'n' group of pair of points near feature point and then compute gray value of the points to form binary string as feature descriptor. It is observed that ORB is far superior in time efficacy when compared to SURF and SIFT. [4]

It is seen that most of the methods concentrate on improving a single method to improve one of the four main steps of object identification. It is seen that the improvement is confined to specific data sets and on generalization or on change of datasets seem to fade out the advantages. The main difference between the ORB and SIFT has been speed of identification. The paper uses both the speed and the consistency with a slight tradeoff of 24.4% for images which are crosschecked. This provides the algorithm with novel framework that incorporates the advantages of SIFT and ORB.

3. RESEARCH METHODOLOGY

Independent procedures on Brisk and ORB were conducted to record the time taken for execution to identify the candidate object in the self-constructed dataset. As the features were already extracted before getting into this routine, there existed a binary bit string descriptor for the candidate image and hence only the image under consideration was considered for execution time. As we found not much of a difference on our dataset it was decided to use ORB and list the images that the object image in them. This lead to a few images not being identified and rejected for not having the object image. It is our objective to improve the recognition rate and hence used the Euclidean distance descriptor used by SIFT and also increased the percentage of relevant features considered by 10% and then removed the outliners. Experiment results reveal that the wrongly reject images were also identified to be having the image. This leads to improvement of efficiency in time along with increase in efficiency in object detection.

4. INTERLEAVED FEATURE EXTRACTION MODEL

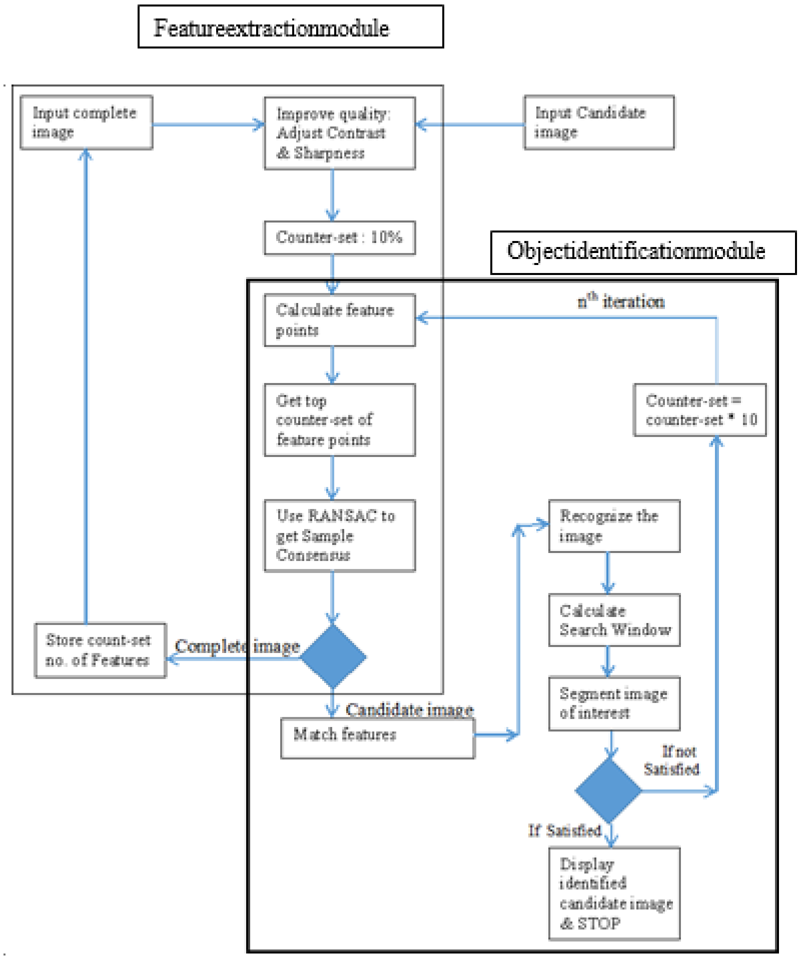


FIGURE 1. Model for feature extraction and identification

5. PROCEDURE

The process of locating an object in an image of cluttered scene involves a careful analysis of the problem where in the challenges could be enormous. It is observed during the course of the study that these challenges are more specific to the problem and needs human intervention till the system is trained and a general robust algorithm is built. This step constitutes the need of "Supervised learning" which after a period of time and number of problems solved can be let to unsupervised extraction of knowledge. The list of input images from which the candidate image is to be identified from the web is first considered for feature extraction. This could be a background process or if time permits and the samples are less can be considered for processing during identification process. It is considered that the feature extraction module is an offline process. In the procedure put across we would not extract all the features of the set of images from whom the image is to be identified as it is not practical nor feasible to store these features. Instead we would start out process with the candidate image that needs to be identified.

Some of the challenges encountered during this object deduction module are that the object in the given image may be rotated, the scale of the object could be different or it could a situation where the edges of some part of the image may be hidden. This does not allow us to use the templet methods to identify this object from the web. Hence the lookout for new algorithm that are more robust and compatible with machine learning id developed.

The algorithms BRISK and ORB have binary bit string descriptors. They use Hamming distance calculations. SIFT and SURF are also bit string descriptive but use Euclidean distance descriptors. This leads to more time and hence reduce in speed efficiency. It is seen that BRISK and ORB skip identification of objects due to various reasons. In the above framework, in first pass we find the features of a candidate image using BRISK and ORB but found very little difference with respect to Detected feature numbers, Detection time and total time. Hence the algorithm proposes to use ORB in the first pass and if the object is not identified the second pass leads to use of SURF with much more features with an increase of 10%. This provides excellent object detection.

The trade off in time efficiency is negligible in comparison to success rate of over 99.2%. The work here uses candidate image to deduct features. The solution uses" detect SURF features" to get features from the candidate image. These features are stored in the form of a feature vector. The larger image feature vector is not so easy to handle even by the best of best processor available in the retail market and hence it was decided to reduce the feature vector to get into 10% of the feature vector, which roughly was calculated to around 20% features. These 20% strong features constitute the candidate image features. The search image is as well is reduced to the feature vector and compared with the candidate image's feature vector. The percentage of window drawn around the image was found to be not satisfactory as some of the features were also found outside the object. In order to remove such extra features identification, we use Random Access Consensus RANSAC algorithm. This provides best results with Match feature function. The bounding box is a perfect match even if there are more than one match in the image. The algorithm used as follows:

6. DATA SET OF IMAGES USED

FIGURE 2. Image directory

FIGURE 3. Not identified in first Pass but identified in second pass

FIGURE 4. Image directory

FIGURE5. Not identified in first Pass but identified in second pass

FIGURE 6. Image directory

7. RESULTS

It is seen from the table 1 that ORB detects the maximum of features and the features are concentrated near the boundary. This leads to more matching costs and hence an outliner algorithm becomes necessary. The computation cost for detecting the features is less as compared to other methods. SIFT features are in scattered form; however, it is more accurate feature detector for scale, rotation and affine variations of the object. Hence we first ORB and if an image is not detected then we use SIFT which is slow but more efficient to confirm the missing of the object in the given image. This clearly indicates that if we use only ORB then we will be fast but may miss a few images in which images exists or if we use only SIFT we will have more opportunity to identify the image but time consumed is more, hence wherever possible we quickly identify the image and only for those images where object is not identified is subjected to SIFT in the next iteration with an increase of 10% relevant features to confirm the missing of the image. The framework produces excellent results if the data set has more number of images with the object. The time taken by SIFT being almost 1:3 in our data set we find only the images that are not identified in the first pass of the algorithm are taking more time and hence the average time per image is reduced in comparison to using only SIFT. This framework provides an absolute trade-off between speed and efficiency.

TABLE 1. Quantitative comparison of ORB&SIFT feature detector descriptors along with computational time

Algorithm	Feature Detected in Images		Features matched	Outliners rejected	Feature detection & description time (s)		Feature matching (s)	Outliner rejection time (s)	Total object detection time(s)
Banana(Dataset1)									
ORB	3612	3981	262	12	0.0211	0.0224	0.1182	0.0041	0.1658
SIFT	1418	1603	129	34	0.1623	0.1921	0.1012	0.0048	0.4604
Zebra Crossing(Dataset2)									
ORB	890	928	316	16	0.0072	0.0078	0.0112	0.0043	0.0305
SIFT	1296	1462	362	14	0.1465	0.1482	0.0591	0.0049	0.3587
Signallights(Dataset3)									
ORB	4916	6213	93	19	0.0261	0.0299	0.2580	0.0076	0.3216
SIFT	2128	3161	126	69	0.2713	0.3121	0.2810	0.0073	0.8717

8. CONCLUSIONS

The main objective of the paper was to achieve 100% object identification in given directory of images. On understanding the fact that no one method is best or can be accepted as a general method of feature identification and identification, the paper makes an attempt to use time efficient method like ORB and on non-detection of image, same feature vector is used with enhanced percentage of features to detect the object using methods SIFT or SURF (Both have almost same time efficiency) which are much less time efficient but more detecting efficient. Aresultof99.20%isachieved using this framework. However, when very blur images like the one in Fig 6, 2nd fig is considered, it is seen that both the ORB and SIFT produce the same results with detecting nearby resembling objects, which may be of concern in applications that may need more detection accuracy.

REFERENCES

[1]. Ashish Kumar Bhandari, Immadisetty Vinod Kumar, Department of Electronics and Communication Engineering, National Institute of Technology Patna, Patna, 800005, India, “A context sensitive energy thresholding based 3D Otsu function for image segmentation using human learning optimization”. https://doi.org/10.1016/j.asoc.2019.105570.

[2]. B. Liu, W. Zhao, and Q. Sun, " Study of object detection based on Faster R-CNN," in 2017 Chinese Automation Congress (CAC), 2017, pp. 6233-6236.

[3]. Bhavan A. Jasani, Siew-Kei Lam, Member, IEEE, and Pramod Kumar Meher, SeniorMember, IEEE, and Meiqing Wu, “Threshold-Guided Design and Optimization for Harris Corner Detector Architecture” IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY [2018]

[4]. Lemley, J.,Bazrafkan,S., & Corcoran,P.(2017): DeepLearning for Consumer Devicesand Services: Pushing the limits for machine learning, artificial intelligence, and computer vision. IEEE Consumer Electronics Magazine, Vol. 6, No. 2, pp. 48-56.

[5]. Li Xin,Shi YiLiang (2018): Computer Vision Imaging Based on Artificial Intelligence, 2018 International Conference on Virtual Reality and Intelligent Systems, 978-1-5386-8031- 5/18/$31.00 ©2018 IEEE DOI 10.1109/ICVRIS.2018.00014

[6]. Lubna Shahid, Farrokh Janabi-Sharifi, Patrick Keenan, Ryerson University, Robotics, Mechatronics andAutomation Lab, Mechanical and Industrial Engineering Department, Toronto, Canada, “A hybrid vision-based surface coverage measurement method for robotic inspection”, Robotics and Computer Integrated Manufacturing, https://doi.org/10.1016/j.rcim.2018.11.009.

[7]. Michael Villamizar, Juan Andrade-Cetto, Member, IEEE, Alberto Sanfeliu, Member, IEEE and Francesc Moreno-Noguer, “Boosted Random Ferns for Object Detection”, 2019, IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE

[8]. Mohamed H. Merzban, Mahmoud Elbayoumi, Electrical Engineering Department, Faculty of Engineering, Fayoum University, Fayoum 63514, Egypt, “Efficient solution of Otsu multilevel image thresholding: A comparative study”, https://doi.org/10.1016/j.eswa.2018.09.008 0957- 4174/© 2018 Elsevier Ltd.

[9]. Puneet GRDIET, Naresh Kumar Garg, BATHINDA Department of Computer Science & Engineering, GZSPTU Campus, BATHINDA Department of Computer Science & Engineering, “Binarization Techniques used for Grey Scale Images”, International Journal of Computer Applications (0975 – 8887) Volume 71– No.1, June 2013

[10]. Sergei Alyamkin, Matthew Ardi, Alexander C. Berg, "Low-Power Computer Vision: Status, Challenges, and Opportunities", JOURNAL ON EMERGING AND SELECTED TOPICS IN CIRCUITS AND SYSTEMS, arXiv:1904.07714v1 [cs.CV] 15 Apr 2019.

[11]. Sergei Alyamkin, Matthew Ardi, Alexander C. Berg, "Low-Power Computer Vision: Status, Challenges, and Opportunities", IEEE JOURNAL ON EMERGING AND SELECTED TOPICS IN CIRCUITS AND SYSTEMS, VOL. 9, NO. 2, JUNE 2019

[12]. Thamiris de Souza Alvesa, Caterine Silva de Oliveirab, Cesar Saninb, Edward Szczerbickic, School of Electrical Engineering and Computing, University of Newcastle, Callaghan, NSW, Australia,SchoolofEngineering,UniversityofNewcastle,Callaghan,NSW,Australia,Faculty of Management and Economics, Gdansk University of Technology, Gdansk, Poland, "From Knowledge based Vision Systems to Cognitive Vision Systems: A Review", International Conference on Knowledge Based and Intelligent Information and Engineering Systems, KES2018,3-5September2018,Belgrade, Serbia

[13]. Kaixuan Zhao, Xin Jin, Jiangtao Ji, Jun Wang, Hao Ma, Xuefeng Zhu, College of Agricultural Equipment Engineering, Henan University of Science and Technology, Luoyang 471003, China, Collaborative Innovation Center of Machinery Equipment Advanced Manufacturing of Henan Province, Luoyang 471003, China, Key Laboratory of Agricultural Internet of Things, Ministry of Agriculture Rural Affairs, Yangling, Shaanxi 712100, China, "Individual identification of Holstein dairy cows based on detecting and matching feature points in body images",https://doi.org/10.1016/j.biosystemseng.2019.03.004 1537-5110/© 2019 IAgrE.

[14]. Ethan Rublee Vincent Rabaud Kurt Konolige Gary Bradski, Willow Garage, Menlo Park, California, {erublee}{vrabaud}{konolige}{bradski}@willowgarage.com, "ORB: an efficient alternative to SIFT or SURF".

[15]. Amila Jakubovi, Jasmin Velagi, Faculty of Electrical Engineering/University of Sarajevo Sarajevo, Bosnia and Herzegovina, jasmin.velagic@etf.unsa.ba, "Image Feature Matching and Object Detection Using Brute-Force Matchers", Conference Paper · September 2018, DOI: 10.23919/ELMAR.2018.8534641