

# Object Recognition and Detection in Remote Sensing Images: A Comparative Study

Syed Aley Fatima

Computer Science & Engineering  
Vardhaman College of Engineering  
Hyderabad, 501 218, India.

Ashwani Kumar

Computer Science & Engineering  
Vardhaman College of Engineering  
Hyderabad, 501 218, India.

Ajay Pratap

Computer Science & Engineering  
Member Secretary-Research Cell, AIIT  
Uttar Pradesh, Lucknow Campus.

Syed Saba Raoof

Computer Science & Engineering  
Vardhaman College of Engineering  
Hyderabad, 501 218, India.

**Abstract**—In this paper, we have provided a brief literature survey of object recognition & detection in remote sensing. These scene recognition images have more components and more challenging issues in the range of aerial image resolutions. It also shows a critical act as a limited area based on functions. The object detection in optical remote sensing has the best critical part of over supposing conditions of characteristic against affecting a model inputs. Certain moving characteristic act as a set of quality to define a based on personal action. This paper provides a brief summary of different object detection in remote sensing images and also discuss about their strength and limitation. The main focus of this review paper is on the satellite image. A subsists in patent of scene recognition of current model act on a freshly process. Inter relates to the land uses analysis system, other model analysis process as well as turn to the appropriate function. We have also discussed the problems and advancement of current scenario and give three research directions for deep learning for medical image recognition, image classification, and health care. We ensure this review article will provide adequate directions and scope for the betterment of the research community in the field of object recognition & detection in remote sensing.

**Keywords**—Object Recognition, Object Detection, Remote Sensing, Scene Recognition, Deep learning

## I. INTRODUCTION

These scene recognition most complete wherever inclined aerial or at all time has particular either else articles attachment into affect self activity also detect to locate based on individual conclude article modal. Affecting word oppose worn to current that review to indicate speculate against along with man -made articles such as (flying machine, automobiles, boats, architecture, etc.) this accept pointed points to separate history, climate including scene articles, e.g. land-use/land-cover (LULC) packages this accepts ambiguous edges along with the articulate based on historic climate. Object detection is a very high resolution (VHR) in remote sensing images. In this terminology of human activities understanding to continue to compensate consideration as decreasing affecting burned off affecting the control's parent. Latest procedure to understand adjustable exercise acceptance beyond need into specific landscape appeal crucial into expand the evaluation process based on condition attribute about personal action In other words, affecting the condition attribute also called landscape recognition or scene understanding. For structural issues allow as scene recognition of diverting critical act for both army and private operations. Object detection has binary critical points current grassland in scene recognition also in functions. Object detection algorithms use features which can be derive to recognize a local object. Remote sensing

images are affecting dynamite rise in quality and quantity also there have different requirement in advanced function field. In this common scene recognition function consist of control air pollution, erosion, etc. This research article is structured as follows: First section shows the introduction of the object detection. The second section provides the taxonomy of object detection based methods. In the third section we have shown the paper reviewed. Section four gives research directions and scope of the research in the fields of object detection. Finally, the fifth section concludes the review paper.

## II. OBJECT DETECTION METHODS

Object detection in remote sensing images can be detected using four techniques: first Machine learning-based, second object based image analysis (OBIA), Knowledge based, and last Template matching based. Machine learning-based algorithms are used for feature extraction, feature fusion to reduce dimension and training the classifier. In image segmentation and object classification OBIA based method is used. The Knowledge based algorithm are geometric and context knowledge. Whereas template matching based algorithm are used for matching rigid and deformable matching templates. Fig.1.Represents the taxonomy of different object detection methods. Rounded rectangles represent the scope of research in the field of object detection. Object detection is performed by estimating the coordinates and class of a particular object in the picture.

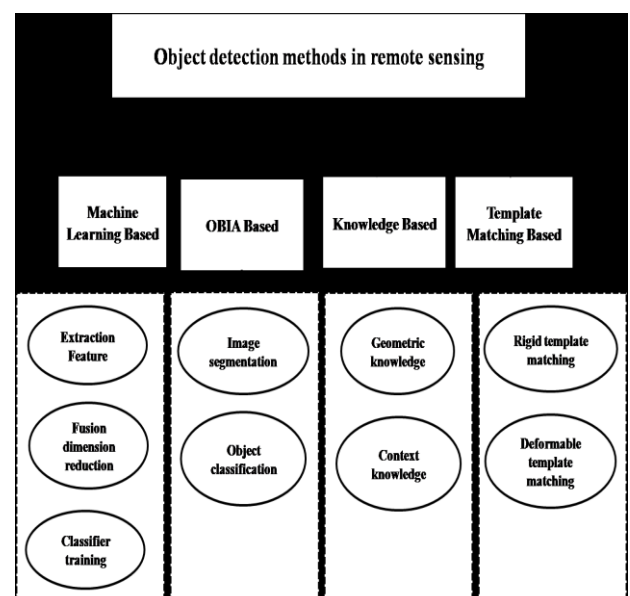


Fig.1.Different objects detection technique.

### A. Faster RCNN:

Region Proposal Network for generating regions and detecting objects uses two methods of Faster-RCNN R. Girshick [1]. The first method proposes regions and uses the proposed regions respectively. Fig. 2 demonstrates the architecture of Faster-RCNN J. Sun [2]

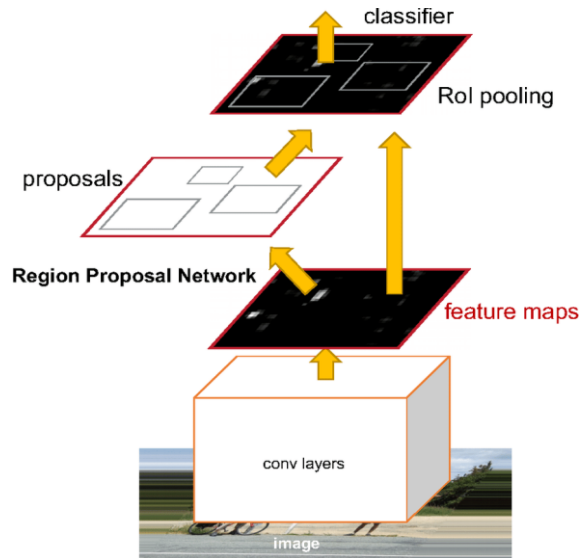


Fig.2. Architecture of Faster-RCNN [2]

### III. PAPER REVIEWED

In this section we have provide the literature review of object detection and recognition for remote sensing images. Normally when object detection has limited statistic based on article in plain neural network expected into limited complication that changes into improved work with regard to transform speed. Although appeal acquire a considerable difficulty current condition based on certainty work. Object detection methods are classified in four types. They are machine learning based process, OBIA-based process; knowledge based process, and template matching-based process, also exclusively analyzed the system. In object detection there are three standard evaluation metrics and five available datasets which are again compile. Also this individually again studies affecting current objection also binary auspicious analysis control which named as deep learning-based article images also anile managed learning – based geospatial scene recognition. In progress machine learning approach has dynamic article also classifier various access regarding scene recognition. In distribution improvement acquire conclude important methods. Affecting classifier is provider set of regions with their respective feature as input and the respective predicted labels as output.

Recently, object-based image research (OBIA or GEOBIA for geospatial object based image research) accept to develop a advanced procedure to analyze outline VHR symbolism to important article like organization based on newly provincial comparable component with developing opportunity also expanded application based on sub-meter symbolism it gives a flowchart of OBIA-based object detection. OBIA engross binary points: (I) Model Analysis has firstly imagery in homogeneous has association based on component determining compactness criteria, crave scales, also shapes. (II) Object classification has the object shapes and classification process has applied for this object. In object detection another method is knowledge-based

methods it has popular approaches in optical RSIs in object detection and it has extensive collection of papers which has been published in building and another more prevalent object taking out application such as rock fall flyovers, automobiles, metropolitan land changes, sewage, bush land. In object detection the template matching-based process continue a particular based on affecting categories in the elementary also original access. In this binary essential points current template matching-based process in scene recognition groundwork object detection framework.

- Template generation: The template T has into expose against article class determining by essentially achieve by hand-crafting.
- Similarity measure: at each possible expert model, affecting to save in template T has into contest affecting model points and asset affecting choice contest.

All allowable translation, rotation, and scale changes into affecting depth misinterpretation or ceiling interaction part. Bayesian hierarchical have proposed images to determine also observe object detection P. Peron [3]. In this prospective design does not appropriate annotating affecting exercise attitude based on object images by a lot of resident region situated at individually literature. That process also called as bag based on optic word or code word. For affecting conclusion based on affecting object detection analysis, 76% efficiency is access against 650 exercise illustration against all 13 kinds are achieved. In another work bag of code word represent the global features and local features with in sub region by partitioning an image C. Schmidt [4]. That is a actual time of scene recognition system has circle graph as a instruction objective (Ti) is design against affecting all absorption away for accepting YOLOv2 Ali Farad [5]. Supposing affecting article point also affecting article collection features of YOLOv2 against affecting model. Fig 1 displayed illustration based on scene recognition by YOLOv2. Against that fig. individual canister asset this horde article (cars, bikes, persons.) do auspiciously expose. Exclusively a few bikes after cars canister away to expose alike whenever we can exclusive observe a separate based on authority. Individually appropriate affecting 80 article classes expose based on YOLOv2. To analyze affecting relation between affecting accuracy of scene categories and number of image data. To estimate the efficiency in case of noisy objective model data set of scene categories. Affecting to convert and circulate is classified to binary circulate: they are first affecting objective formulation to circulate (color in red). Second affecting object detection circulates (color in blue). Scene category names as label and label are used as keyword to bring back images. Based on 26 labels number based on model concealed by Innovative Common License against sharing SNS services Flickr [6]. The object detection collects all images to perform the result and merged specifying each landscape division, affecting image are set of specific scene division that contain density and sign based on object expose. Affecting object list is created by scene category templates.

Latest affecting actual object detection display dataset individual display consist of single considerate based on effective article and also various history. Display marker only history affecting class group based on affecting effective article in individual display, also do not involve any ability around affecting statistic, area, length or direction

based on the article or history Cheng et al., [7]. Albeit auspicious conclusion include act described these design still cannot do competent in an end to end plan. Current affecting most modern period, field outline-based design testing anemic control include prospective to number of scene recognition Belen and Vidalia [8]. Camera will capture the object images and object detector will perform the object images which will be creating the object scene. Using the object list histogram is created similar to scene template creation flow. About affecting support based on adherents equalization with design circle graph is correlated along any landscape division objective. Equation 1 represents the correlation.

$$Z_i, k = \text{sim}(T(i, k)) \quad (1)$$

where  $Z_i$  denotes an ID of models captured against affecting objective as a set of quality,  $T(i, k)$  denotes a circle graph based on affecting as a set of division objective, also slim denotes a function of a similarity measure.

Shuichi Masuda [9] an attempt accepts to continue devout into forward limited scene recognition issues. Affecting prevalent action Chen, X.; Kendo [10] is to developing the article decision based on limited articles by easily enhancing the data model. Albeit there are frequent object detection images in limited inputs are define as instruction related to a essential model input set, that cause it crucial as practice images concurrence Muggier [11]. Albeit a some WSL access accept to continue enforced to common picture model analysis 10. B. Alex [12], the particular current design cannot be precisely worn to affecting grassland of remote sensing images analysis as they accept to incomplete capacity to knob affecting objection in remote sensing image, that involve huge range network environment along with a statistic based on point object along with random direction. As the conclusion based on landscape division detection, individually access which affecting supposing efficiency based on 14% division was 70% or else. Affecting 9 division out based on them were supposing in affecting efficiency based on 99% or else. Wherever affecting 8 division were supposing in affecting efficiency based on 10% or else. Kumar et al. [13-16] pro-posed different watermarking protocol to provide secure and private transaction between the communicating parties.

#### IV. RESEARCH DIRECTION

In this section we have discussed the research direction to for their contribute in the detection of different objects namely Deep learning for medical image recognition, Deep learning for image classification, Deep learning for health care.

##### A. Deep learning for medical image recognition

In medical model appreciation issues away to accepting appealing biologically-animation planning deep learning is adept into review a hierarchic images based on input to analyze other model collection. Yet assuming that discriminate report individual to disinformation current provincial model lot classic deep learning structure can appease acquire to control design authority after local-level definition.

##### B. Deep learning for image classification

Affecting analysis based on medical model is an element function in computer-aided diagnosis, medical model regeneration also digging. Albeit deep learning acquire to displayed determine edge by conventional approach a particular rely against affecting handcrafted appearance, it debris require expected to affecting important inter-class changes and intra-class analogy produce through affecting dissimilarity based on and explain process and analytic anatomy.

##### C. Deep learning for health care

Heap based on affecting productions deep learning title continue directly analogous into limited-range navigator or analysis design in their pre-commercialized point. Despite deep learning is regularly data its procedure into inventive apparatus a particular accept huge expense function in the real-world analytic climate. A few based on better auspicious benefit envelop comprise inventive case-covering function as well as less exceptionally well-established design as developing the health IT user back-ground.

**Table 1** Performance comparisons of different models on Caltech pedestrian dataset.

Method	Reasonable					
		All	Far	Medium	Near	Partial
<b>SA-Fast RCNN [17]</b>	9.7	62.6	100	51.8	0	24.8
<b>MS-CNN [18]</b>	10.0	61.0	97.2	49.1	2.6	19.2
<b>Comp ACT-Deep [19]</b>	11.8	64.4	100	53.2	4.0	25.1
<b>F-DNN+SS [20]</b>	8.2	50.3	77.5	33.2	2.8	15.1

In table 2 we have shown performance comparisons of different models on Caltech pedestrian dataset. The methods are based on hand-crafted features and deep CNN features. Classic handcrafted features can still earn competitive results with boosted SA-Fast RCNN [17], MS-CNN [18], Comp ACT-Deep [19], F-DNN+SS [20-24].

#### V. CONCLUSION

In this paper we have provided a brief literature survey of object recognition & detection in remote sensing. To understand the detection of object in remote sensing images, it required different attributes and parameters. Hence, this study provided different techniques to detect the object in remote sensing images. Object detection methods are classified in four types such as machine learning based process, OBIA-based process; knowledge based process, and template matching-based process. These scene recognition images have more components and more challenging issues in the range of aerial image resolutions. We have addressed the advancement and problems of current studies and provide three promising research directions in this field. To expand the technology latest structure to automatically accept individual exercise in different object against video data would edge to affecting based on burden on control camera

operant it is necessary into supposing condition characteristic in landscape division, basic affecting movement. The review paper will be very important for the researchers to better understand the concept of object recognition & detection in remote sensing.

## REFERENCES

- [1] R. Girshick, "Fast R-CNN," in IEEE International Conference on Computer Vision (ICCV), 2015.
- [2] S. Ren, K. He, R. Girshick, and J. Sun. Faster r-cnn: Towards real-time object detection with region proposal networks. In *Advances in neural information processing systems*, pages 91–99, 2015. Author, F.: Article title. Journal 2(5), 99–110 (2016).
- [3] Li. Fei-Fei and P. Peron: A Bayesian hierarchical model for learning natural scene categories, IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2005), pp. 524–531, 2005.
- [4] S. Lazebnik, C. Schmidt and J. Ponce: Beyond bags of features: Spatial pyramid matching for recognizing natural scene categories, IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2006), pp. 2169–2178, 2006.
- [5] Joseph Redmond and Ali Farad. . "YOLO9000: better, faster, stronger". ArXiv preprint, arXiv: 1612.08242, 2016
- [6] "Flickr", Internet: <https://www.flickr.com/>, [Mar. 28, 2018].
- [7] Cheng, G., Han, J., 2016. A survey on object detection in optical remote sensing images. *ISPRS J. Photogram. Remote Sens.* 117, 11–28.
- [8] Belen, H., Vidalia, A., 2016. Weakly supervised deep detection networks. In: *Proceedings of the 2016 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR 2016)*. IEEE, Las Vegas, pp. 2846–2854.
- [9] Shuichi Masuda, Yuki Kauri, Yusuke Manabi, and Kenji Sugawara: Scene Recognition Method by Bag of Objects Based on Object Detector (2018) pp. 978-1-5386-2633-7/18.
- [10] Chen, X.; Kendo, K.; Zhu, Y.; Berneshawi, A.G.; Ma, H.; Fiddler, S.; Artisan, R. 3D Object Proposals for Accurate Object Class Detection. *Lect. Notes Bus. Inf. Process.* 2015, 122, 34–45.
- [11] Emmanuel Maggiori, Yuliya Tarabalka, Guillaume Charpiat, Pierre Alliez, "Convolutional neural networks for large-scale remote-sensing image classification", IEEE TGRS, 2016.
- [12] B. Alex, T. Desolaters, and V. Ferrari, "Measuring the objectness of image windows," IEEE Trans. Pattern Anal. Mach. Intel., vol. 34, no. 11, pp. 2189–2202, Nov. 2012.
- [13] Kumar, Ashwani, S. P. Ghrera, and Vipin Tyagi. "An ID-based Secure and Flexible Buyer-seller Watermarking Protocol for Copyright Protection." *Pertanika Journal of Science & Technology* 25.1 (2017).
- [14] Kumar, Ashwani, Satya Prakesh Ghrera, & Vipin Tyagi, "Modified Buyer Seller Wa-termarking Protocol based on Discrete Wavelet Transform and Principal Component Analysis", *Indian Journal of Science and Technology*, 8(35), 1-9, 2015.
- [15] Kumar, Ashwani, Satya Prakesh Ghrera, & Vipin Tyagi, "Implementation of wavelet based modified buyer-seller watermarking protocol", *WSEAS Trans. Signal Process.* 10, 212–220, 2014.
- [16] Kumar, Ashwani. "Design of Secure Image Fusion Technique Using Cloud for Privacy-Preserving and Copyright Protection." *International Journal of Cloud Applications and Computing (IJCAC)* 9.3 (2019): 22-36.
- [17] J. Li, X. Liang, S. Shen, T. Xu, J. Feng, and S. Yan, "Scale-aware fast r-cnn for pedestrian detection," arXiv:1510.08160, 2015.
- [18] Z. Cali, Q. Fan, R. S. Feris, and N. Vasconcelos, "A unified multi-scale deep convolutional neural network for fast object detection," in *ECCV*, 2016.
- [19] Z. Cali, M. Siberian, and N. Vasconcelos, "Learning complexity-aware cascades for deep pedestrian detection," in *ICCV*, 2015.
- [20] X. Du, M. El-Khamy, J. Lee, and L. Davis, "Fused dnn: A deep neural network fusion approach to fast and robust pedestrian detection," in *WACV*, 2017.
- [21] Ashwani Kumar et. al., "A Lightweight Buyer-Seller Watermarking Protocol Based On Time-Stamping and Composite Signal Representation" *International Journal of Engineering & Technology*, 7 (4.6) (2018) 39-41.
- [22] Kumar, A., & Shailaja Rani, P. B, Digital Image Forgery Detection Techniques: A Comprehensive Review, In 2019 IEEE 3rd International Conference on Electronics and Communication and Aerospace Technology (ICECA 2019), 12-14 June 2019, Hotel Arcadia, Coimbatore, IEEE.
- [23] Ashwani Kumar, "A Review on Implementation of Digital Image Watermarking Techniques Using LSB and DWT" in the Third International Conference on Information and Communication Technology for Sustainable Development (ICT4SD 2018), held during August 30-31, 2018 at Hotel Vivanta by Taj, GOA, INDIA.
- [24] Pawan Singh, Ashwani Kumar and Mohit Kumar, "RSA using Montgomery Powering Ladder on Dual Core" in the Third International Conference on Information and Communication Technology for Sustainable Development (ICT4SD 2018), held during August 30-31, 2018 at Hotel Vivanta by Taj, GOA, INDIA.

**Table 2** A brief summary of object recognition & detection with strength and limitation.

S. No	Paper title	Tampering Method Type	Pros/cons
1	A survey on object detection in optical remote sensing images.	Spoke wheel algorithm, Artificial bee colony algorithm, Edge potential algorithm.	The classification rules are still subjective to define expert knowledge of shapes to sensitive and changes view point.
2	Scene Recognition Method by Bag of Objects Based on Object Detector.	Convolution deep neural network.	The operator can watch the number of video data.
3	Automatic image registration based on plain objects detection and recognition in remote Sensing tasks.	Fourier Transform, RANSAC algorithm,	The system allows to register images using parametric, non-parametric, hybrid image registration methods in remote sensing applications.
4	Exploring Models and Data for Remote Sensing Image Caption Generation.	LSTM networks Recurrent neural network (RNN).	The image caption methods for natural image can be transferred to remote sensing image to obtain only acceptable descriptions.
5	Multi-scale object detection in remote sensing imagery with Convolution neural networks.	Deep learning algorithm, Inter-frame algorithm and Otsu's algorithm.	It effective than existing algorithms For densely peaked small size objects and also effective for training multi-modal remote sensing Images.

6	Object Recognition in Remote Sensing Images Using Combined Deep Features.	Convolution Neural Network (CNN).	Vector pooling and feature combination strategies are effective, achieving a significant improvement in object recognition performance.
7	Deep networks under scene-level supervision for multi-class geospatial Object detection from remote sensing images.	Fourier transform-based, Multi-Class Geospatial Object Detection	Geospatial object detection does not depend on bounding box to saves annotation cost, and still requires a semantic category correspondence between objects and scenes.
8	Small Object Detection in Optical Remote Sensing Images via Modified Faster R-CNN.	R-CNN algorithm	Author conducted a wide range of experiments and provided a comprehensive analysis of the performance of our modified Faster R-CNN on the task of small object detection in optical remote Sensing images.
9	Object Detection in Remote Sensing Images Based on a Scene-Contextual Feature Pyramid Network	FPN algorithm.	The greatest model uses the horizontal bounding boxes for detection.
10	Object Detection in Optical Remote Sensing Images Based on Weakly Supervised Learning and High-Level Feature Learning	Parallel-beam Radon transform, Ridge let transform and Negative mining algorithm.	Which offers a more powerful descriptor to capture the structural information Of objects in RSIs.

In table 1 we have reviewed different research paper in the field of object detection in remote sensing and listed out their strength and limitation.