Review on Detection of Objects In Drone Images

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Abstract- *With the advent of drones, new potential applications have emerged for the unconstrained analysis of images and videos from aerial view cameras. Despite the tremendous success of the generic object detection methods developed using ground-based photos, a considerable performance drop is observed when these same methods are directly applied to images captured by Unmanned Aerial Vehicles (UAVs).Armies are using drone aggressively, and they constantly need a person to keep attention if there is a movement in the frames.Directly benefiting from the deep learning methods, object detection has witnessed a great performance boost in recent years.One of the typical solutions is to use Convolutional Neural Networks (CNNs) to train detection model by taking single frame as input.*

Keywords- Deep learning, computer vision, object detection, drone, sample imbalance, super-resolve GAN.

I. INTRODUCTION

Object detection has been widely studied for decades. The most famous detectors, such as those used for surveillance, mainly focus on the object of interest in images captured by ground-based cameras. However, with the advantages of low cost, high flexibility, simple operation, and a small size, camera-equipped drones have been rapidly developed and deployed to replace satellites and cameras for a wide range of applications, such as in agriculture, aerial photography, delivery, surveillance, as well as in other fields . Object detection is therefore one of the key technologies that will improve the perception capability of drones, and in addition, it is the basis for other intelligent algorithms, such as segmentation , object tracking , crowd estimation, etc. Despite the high demand for this technology, the drone-based detection algorithm still poses more challenges than the traditional ground-based detection algorithm. Progress has been slow in the research on object detection for drones, and this has gradually become one of the bottlenecks restricting the development of drones. The level of accuracy and real-time object detection will determine whether the drones' mission will end with the destruction of the aircraft or its safekeeping. Limited by electric power, range, and environment, the drone-based object detection algorithm brings certain challenges:

The instability of fast-moving UAVs means that aerial images are often blurred and noisy. In addition, less feature information is extract-able from these moving targets, the drone may repeatedly detect the same object, and it may falsely detect a target;

- The objects in need of detection are generally small in the images. This means that when the UAV takes photos from high up, small targets are easily missed.
- The UAV's continuous movement and the changes in the external environment (such as light, clouds, fog, rain, etc.) lead to drastic changes in the target's features within the image, and thus increase the difficulty of subsequent feature extraction.
- The drone-based object detection algorithm needs to quickly and accurately detect moving targets , so the algorithm must meet real-time computing requirements.

Since the target usually appears small in drone images, the object's features are often unclear and can easily be confused with the features of other objects. In addition, having excessive background in the image can lead to having too many negative samples in the training process, which affects detection accuracy. Motivated by these observations, this paper aims to improve the efficiency and accuracy of a drone object detection system based on the challenges mentioned above. We offer to study an object detection model based on the idea of an anchor-free framework that can reduce the amount of computation of IoU (Intersection over Union). In order to adapt the positive and negative samples, we propose new sample selection strategies. In addition, the weight-Generative Adversarial Network (GAN) sub-network is proposed to enhance the features locally. Following this, experiments carried out on VisDrone datasets are used to demonstrate our method's advantage over state–of–the–art detection method

Fig. 1.1 Drone Image Object view

II. LITERATURE SURVEY

2.1 Deep Learning for Generic object detection survey on International Journal of computer vision.

Author – Wanli Ouyang, M. Pietiekainen. Date- 6 September 2018.

A comprehensive survey on the recent achievements in this field brought about by deep learning techniques, covering many aspects of generic object detection : Detection frameworks, object feature representation, object proposal generation, context modeling, training strategies and evaluation matrix.

Object detection, one of the most fundamental and challenging problems in computer vision, seeks to locate object instances. Deep learning techniques are emerged as a powerful strategy for learning feature representations directly from data and have led to remarkable break thoughts in the field of generic object detection. Given this period of rapid evoluation, the goal of this paper is to provide a comprehensive survey of the recent achievements in this field brought about by deep learning techniques. More than 300 research contributions are included in this survey, covering many aspect of generic object detection.

2.2 Feature Fusion methods in Deep-Learning Generic Object Detection survey on IEEE 9th joint International Information.

Author – Jiang Deng, Sun Bei, Zuo Zen. Date – 11 December 2020

Feature fusion has become one of the most popular orientations in object detection, which has been widely applied to enrich object representation, especially for the small objects. In this paper, we introduce some classical backbone networks which adopt feature fusion methods. Then we analyses the fusion techniques of several typical or state-of-the-art frameworks.

Third represent a synthesize survey of fusion strategies. At last, the future development trends and challenges are summarized.

2.3 Exploring Deep Learning-based architecture, strategies, applications and current trends in Generic Object Detection survey on IEEE access

Author – Lubna Aziz, Md. Shah Bin Haji, U.U. Sheikh, Sara Ayub. Date – 3 September 2020.

A comprehensive survey of recent advances in visual object detection with deep learning, focusing on the application of deep learning architectures to five major applications, namely object detection in Surveillance, Military, Transportation, Medical and Daily life.

This paper provides a comprehensive survey in recent advances in visual object detection with deep learning.

i. Region proposal-based object detection methods such as R-CNN, SPPnet, Fast R-CNN, Faster R-CNN, Mask RCN, RFCN,FPN
ii. Classification or regression based object detection methods such as YOLO, SSD, DSSD, RetinaNet, RefineDet, CornerNet, EfficientDet
iii. Some latest detectors such as relation network for object detection, DCN v2, NAS FPN.
iv. Moreover, five publicaly available benchmark datasets and their standard evaluation metrix are also discussed.

2.4 Object Detection using Deep Learning Methods in Traffic Scenarios survey on ACM computer science.

Author – Hou Zhijun, A. Boukerche. Date – 5 March 2021

This survey is detected to summarizing research and papers on applying deep learning to the transportation environment in recent years and is believed to be the first survey focusing on deep learning-based object detection in traffic scenario. This survey is dedicated to summarizing research and papers on applying deep learning to the transportation environment in recent years. More than 100 research papers are covered and different aspects such as key generic object detection frameworks, categorized object detection applications in traffic scenario, evaluation matrix and classified datasets are included.

2.5 A study on generic object detection with emphasis on future research directions survey on Journal of King Saud University.

Author – Martin Auruldos, Enoch Arulprakash. Date – 12 August 2020

The survey provides a comprehensive study on object representation, Convolution Neural Network (CNN) and different deep convolutional neural network architecture and provides a concise review of renowned datasets and definitive measurement metrics, forming the primitive baseline to evaluate the detection framework.

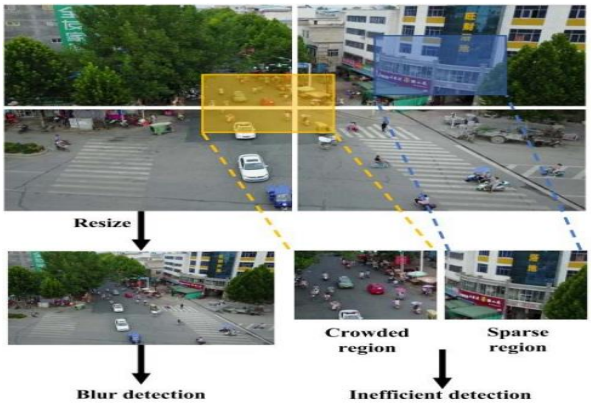

Fig. 2.1. Instable images captured by Drone

III. SYSTEM ARCHITECTURE

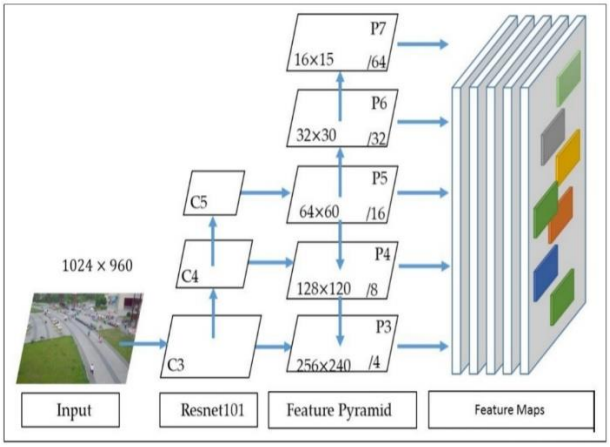

Fig.3.1. Model training

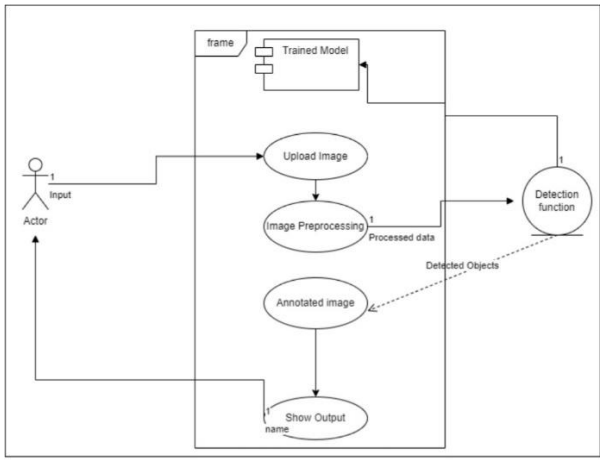

Fig.3.2. System Architecture

IV. CONCLUSION

Drone object detection is an important area of research as it has many applications in real-time. In this review paper, existing research works are studied. The works are categorized according to their applications and methods. It is recommended that future work focuses on testing the approach on various images with a combination of different object classes considering the fact that advancements will have major beneficial impacts on how UAVs implement complex tasks. Specifically, the focus will be on construction site management, such as road and bridge construction, where site features can be tracked and recorded with minimal human intervention. Considering that 3D object reconstruction of construction sites is gaining ground in the construction industry, the ability for the CNN to recognize 3D image reconstructed objects must be assessed. Additionally, UAVs and CNNs could be used to improve the performance of existing vehicle counting and classification tasks in traffic management with minimum interference. Another application area in the transportation field will also be in the automated identification of roadway features such as lane departure features, traffic and road signals, railway crossings, etc. These applications could greatly transform transportation asset management in the near future. From the results, we observed that the detection accuracy of the two models for buildings, trees, cars, and people is very high, with an average of more than 85% and a maximum of 99%. We have done some experimental comparison of two modern object detectors for memory usage, speed, and accuracy.

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