OBJECT DETECTION USING DEEP LEARNING

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Abstract:

Object recognition is an important task in computer vision that involves identifying the objects such as digital images or videos. This research paper provides a comprehensive review of the different techniques and applications of object recognition. The paper first discusses the basic concepts of object recognition, including feature extraction and matching, classification, and detection. Next, the paper reviews the different techniques for object recognition, such as template matching, PCA-based recognition, and deep learning-based recognition. The paper then presents an overview of the different applications of object recognition, including image and video classification, object tracking, face recognition, and autonomous driving. Finally, the paper ends with a discussion of the difficulties and likely new paths for object recognition.

Keywords: Deep learning,Object detection,Neural Network.

Introduction:

Nowadays, Object recognition is a major issue in computer vision that has received a lot of attention. It involves identifying objects in digital images or videos, which has numerous practical applications, such as image and video classification, object tracking, face recognition, and autonomous driving. Object recognition is a challenging task due to variations in object appearance, illumination, and occlusion. Several methods have been suggested in the literature to tackle these difficulties, ranging from traditional feature extraction and matching methods to deep learning-based approaches. This research paper provides a comprehensive review of the different techniques and applications of object recognition.

Related Works:

[1]Considering how closely object detection relates to video analysis and visual comprehension, it has received a lot of study interest lately. The foundation of conventional object detection techniques is shallow trainable structures and handmade features. Building intricate ensembles that incorporate several low-level picture features with high-level context from object detectors and scene classifiers can readily stabilize their performance. In order to solve the issues with traditional architectures, more potent tools that can learn semantic, high-level, deeper features are being offered as a result of deep learning's quick development. In terms of network architecture, training methodology, optimisation function, etc., these models behave differently. In this paper, we explore object detection frameworks based on deep learning. Our review starts with a succinct history of deep learning.

[2]Deepconvolutional neural networks (DCNNs), which have seen increased use as deep learning techniques have developed quickly, are becoming more crucial for object detection. The deep learning-based object recognition algorithms can learn both low-level and high-level picture characteristics, in contrast to conventional handcrafted feature-based methods. The deep learning-based image features are more representative than the manually created features. As a result, while the conventional object detection methods will also be briefly discussed, this review paper concentrates on object detection techniques based on deep convolutional neural networks. This work includes the following sections: backbone networks, loss functions and training strategies, traditional object detection architectures, complex problems, datasets and evaluation metrics, applications and future development directions. It was done through a review and analysis of deep learning-based object detection techniques in recent years.

[3]One of the most important and difficult jobs in computer vision is object detection. It is the process of locating things in an image or video that fall into a set of predefined categories. In this study, object detection algorithms based on deep learning are reviewed. Certain benchmark datasets are discussed in the paper. On the basis of Mean Average Precision (mAP), the effectiveness of various detectors on various datasets is examined. Object detection is employed in a variety of fields and contexts. Applications for object detection are shown, including those for autonomous vehicles, facial recognition, and pedestrian detection. Lastly, the future direction of developing novel object detection methods is highlighted.

[4]Finding instances of objects from a large number of specified categories in real images is the goal of object detection, one of the most fundamental and difficult problems in computer vision. Feature representations may now be learned directly from data using deep learning approaches, which have produced amazing advances in the field of general object detection. The purpose of this work is to present a thorough assessment of the most recent developments in this subject brought about by deep learning techniques during this period of rapid evolution. This survey includes more than 300 research contributions that span a wide range of general object detection topics, such as detection frameworks, object feature representation, object proposal generation, context modeling, training methods, and evaluation metrics. We identify the results of the survey.

[5]Object identification is a crucial, fascinating, and mind-blowing study in computer vision. Object detection is used in many different contexts, including driving on one's own or autonomously, security monitoring, and more. Deep-learning based object detection systems have advanced quickly and caught the interest of many academics. The development of the object-detection framework, thoroughly and honestly, is the primary goal of the twenty-first century. In this inquiry, we first look at and assess the different object detection methods, and then we choose the benchmark datasets. We also organized the broad-ranging general concept of object detection approaches. The first and second stage detectors of object detection techniques were addressed. Finally, we take into account the design of these object detection techniques to provide dimensions for further research.

Basic Concepts of Object Recognition:

Object recognition involves several basic concepts, including feature extraction and matching, classification, and detection. Feature extraction refers to the process of identifying distinctive characteristics of a thing, like edges, corners, moreover texture. The representation of the object is only made using these features, and it may be compared to other things to see if they match . Matching involves comparing the features of the object being recognized to the features of objects in database to find the best match.

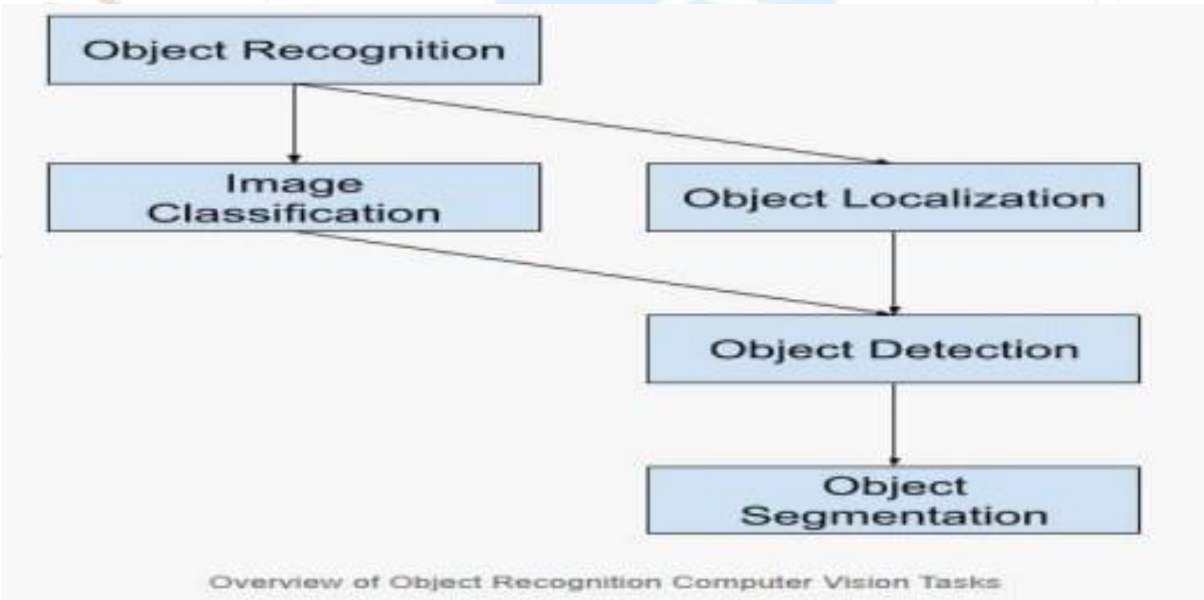

Fig (1)

Assigning a label or category to an object based on its characteristics is the process of classification. Several classification techniques, including support vector machines (SVM), k-nearest neighbor (KNN), and decision trees can be done using this algorithm. Detection involves identifying the presence of an object in an image or video and localizing its position. Object detection algorithms typically use sliding windows or region-based approaches to scan the image or video and identify objects.

Want to add a shape or text box, or input a photo from your computer's files? Try it out! Just tap the required choice on the Insert tab of the ribbon.

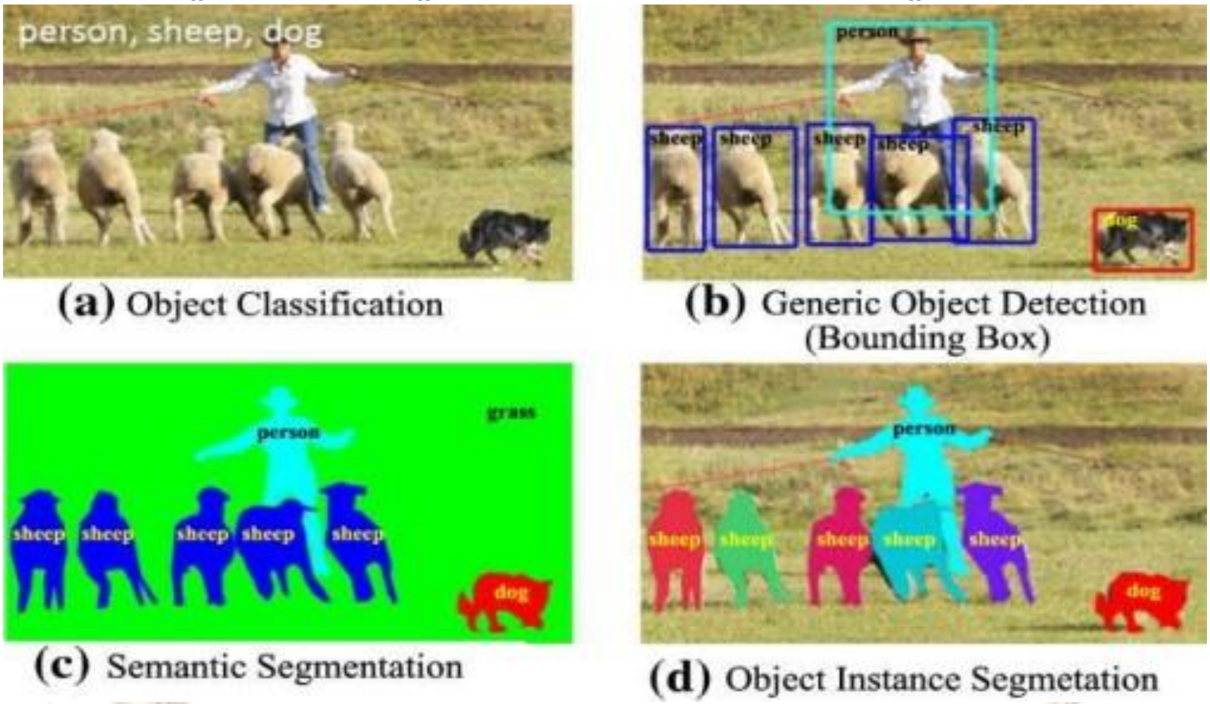

Fig (2)

Object classification:

It refers to the process of categorizing objects into different classes or categories based on their visual characteristics. This task is a fundamental problem in computer vision is implemented in many different applications, including image retrieval, autonomous driving, and object detection.There are various ways for classifying objects, such as convolutional neural networks, support vector machines (SVM), and traditional computer vision techniques including feature extraction and machine learning algorithms like random forests (CNNs).

Deep learning has become the dominant approach for object classification nowadays , because of its ability to automatically learn multiple representations of features from raw image data. In particular, CNNs have demonstrated cutting-edge performance on a number of object categorization benchmarks, including ImageNet, which contains over one million images across 1,000 object categories.

Generic Object Detection:

A computer vision task called "generic object detection" includes locating and identifying items in an image or video. The objective of this task is to build an algorithm or model that can recognize various objects within an image or video, and output their locations in the form of bounding boxes. This type of object detection is "generic" because it does not rely on specific knowledge about the objects being detected, and can work with a wide range of object types. The task of generic object detection is typically broken down into two sub-tasks: classification of objects and object location.
A bounding box is frequently formed around an object to indicate its location inside an image as part of the object localization process. To classify an object, its type must be determined within its bounding box. Several object detection algorithms perform both of these subtasks using a combination of deep learning methods, such as convolutional neural networks (CNNs) and object suggestions.

Generic object detection has many practical applications, including in autonomous vehicles, surveillance systems, and image and video search engines.

Semantic Segmentation:

It is a method of computer vision that includes segmenting an image into groups, each of which represents an individual object or area of the image. Another method of computer vision is object detection, which entails finding and locating items in a picture. By providing more details about the items in an image, semantic segmentation can be used in the context of object detection to increase the accuracy of object detection. Specifically, by segmenting an image into different regions based on their semantic content, object detection algorithms can focus their attention on the regions of the image that are most likely to contain objects of interest.

For example, if an object detection algorithm is looking for cars in an image, it can use semantic segmentation to identify the regions of the image that contain cars, and then focus its attention on those regions when looking for car-like features (such as wheels or windshields).

Overall, the mixture of semantic segmentation with object identification might result in computer vision systems that are more efficient and effective, especially in real-time object detection and tracking applications like automated vehicles or remote monitoring. Object instance segmentation:

It is a computer vision problem that includes locating and detecting specific items in an image or video stream. This is a more advanced form of object detection that not only detects objects but also segments each object instance into its constituent parts or regions. In the context of object detection, instance segmentation involves predicting both the class labels and the precise location of each object instance within an image. This is done by generating a set of bounding boxes that enclose each object, and then using advanced image processing techniques to segment each box into its constituent parts or regions.

There are several deep learning techniques that can be used for object instance segmentation, including Mask R-CNN, U-Net, and FCN. These techniques involve training a neural network on large datasets of labeled images, and then using the trained network to predict the location and segmentation of objects within new images. Object instance segmentation is a crucial task in many computer vision applications, including self driving, robotics, and in medical imaging. By accurately detecting and segmenting objects within an image, computer vision systems can make better decisions and improve overall performance.

Techniques for Object Recognition:

Several techniques have been proposed for object recognition, ranging from traditional feature extraction and matching methods to deep learning-based approaches. Some of the most commonly used techniques include:

Template Matching:

In order to discover the best match, this technique compares an input image to a series of predefined templates. Although straightforward and effective, template matching is sensitive to variations in object size, rotation, and lighting.

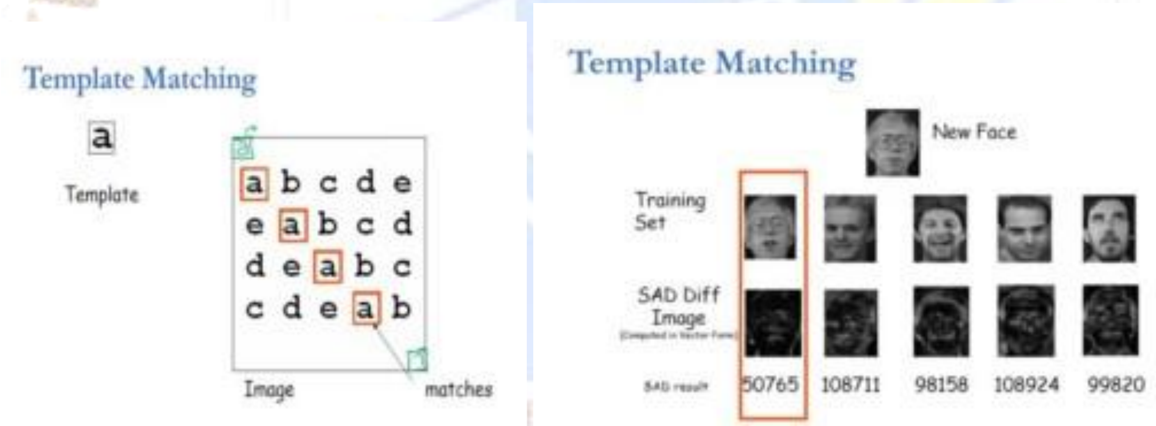

Fig (3)

PCA-based Recognition :

Finding the most important features helps Principal Component Analysis (PCA) reduce the dimensionality of data. PCA-based recognition involves projecting the features of an object onto a lower-dimensional subspace and comparing it to the subspace of known objects.

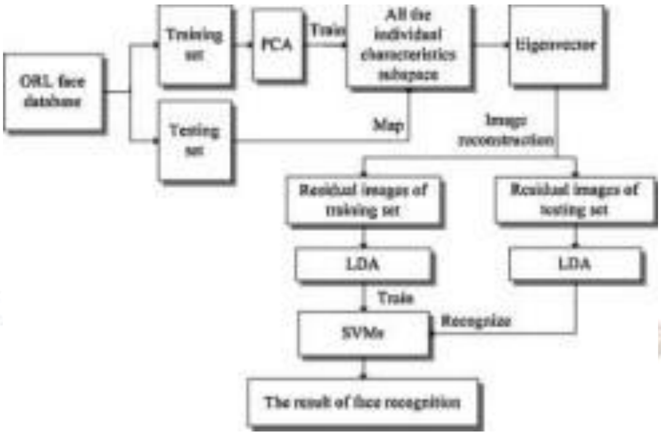

Fig (4)

Deep Learning-based Recognition:

Deep learning is a powerful technique for learning complex features from data. Deep learning-based recognition involves training a neural network on a large dataset of images or videos to learn features that can be used for object recognition.

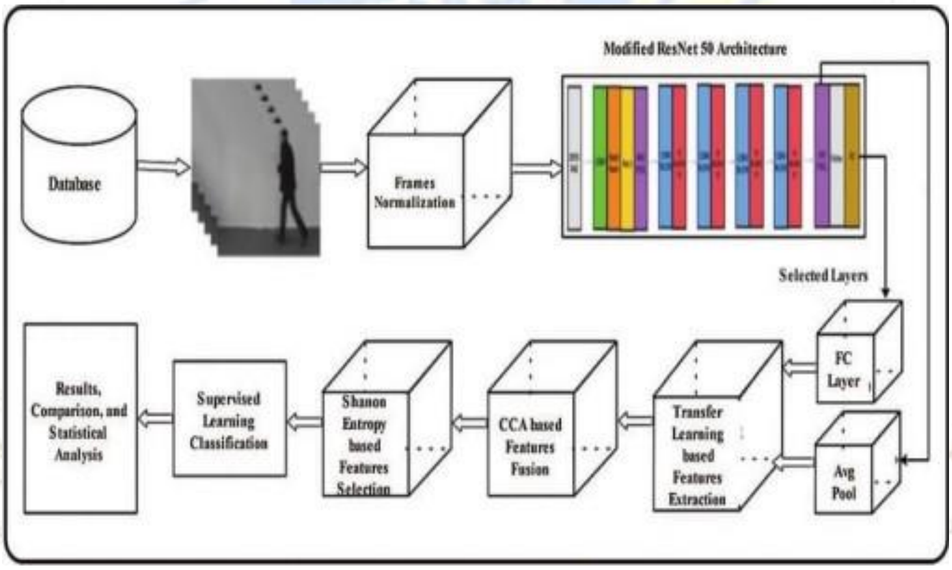

Fig (5)

Conclusion:

Object detection has numerous practical applications, including surveillance, autonomous driving, and medical imaging. It also plays a crucial role in computer vision research, providing a foundation for higher-level tasks include object tracking, semantic division and

image captioning. Despite its successes, object detection remains a challenging problem, particularly when dealing with small objects, occlusions, and cluttered scenes. Researchers continue to explore new techniques to improve detection accuracy, speed, and robustness. These include multi-scale feature extraction, attention mechanisms, and advanced optimization algorithms. Overall, object detection is a rapidly evolving field with numerous challenges and opportunities for research and innovation.In the years to come, we can imagine seeing even more remarkable developments in this field as computer vision continues to develop.

References:

[1] Zhong-Qiu Zhao i,Peng Zheng,Shou-tao Xu,Xindong Wu,"Object Detection with Deep Learning",IEEE transaction on neural network and learning system,in 2019.

[2]Youzi Xiao, Zhiqiang Tian,Jiachen Yu, Yinshu Zhang, Shuai Liu, Shaoyi Du & Xuguang Lan "A review of object detection based on deep learning",SpringerLink in 2020.

[3]Biponjot Kaur, Sarbjeet Singh,"Object Detection using Deep Learning",ACM Journal in 2022.

[4]Li Liu, Wanli Ouyang, Xiaogang Wang, Paul Fieguth, Jie Chen, Xinwang Liu & Matti Pietikäinen,"Deep Learning for Generic Object Detection",SpringerLink in 2019.

[5]Sushma Jaiswal,Tarun Jaiswal,"Deep Learning Approaches for Object Detection",Universal Wiser Publisher in 2020.