Object Detection in Low Spatial Resolution Aerial Imagery Using Convolutional Neural Networks

Object detection is a fundamental task in computer vision, with applications in a wide variety of domains, such as surveillance, remote sensing, and medical imaging. In recent years, convolutional neural networks (CNNs) have emerged as a powerful deep learning technique for object detection. CNNs have been shown to achieve state-of-the-art results on a variety of object detection benchmarks.

However, object detection in low spatial resolution aerial imagery poses a unique set of challenges. Low spatial resolution aerial imagery is often acquired from high altitudes, which results in images with small object sizes. This makes it difficult to detect objects in low spatial resolution aerial imagery using traditional object detection methods.

In this article, we explore the use of CNNs for object detection in low spatial resolution aerial imagery. We discuss the challenges of object detection in low spatial resolution aerial imagery and how CNNs can be used to overcome these challenges. We also provide a detailed overview of a CNN-based object detection system that we have developed for low spatial resolution aerial imagery.

Object Detection in Low-spatial-resolution Aerial Imagery Using Convolutional Neural Networks

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The main challenges of object detection in low spatial resolution aerial imagery are:

- **Small object sizes:** Objects in low spatial resolution aerial imagery are often small, which makes them difficult to detect.
- **Cluttered backgrounds:** Low spatial resolution aerial imagery often contains a lot of clutter, which can make it difficult to distinguish objects from the background.
- **Occlusions:** Objects in low spatial resolution aerial imagery are often occluded by other objects, which can make them difficult to detect.

CNNs are a powerful deep learning technique that has been shown to achieve state-of-the-art results on a variety of object detection benchmarks. CNNs can overcome the challenges of object detection in low spatial resolution aerial imagery by:

- **Learning hierarchical features:** CNNs can learn hierarchical features, which allows them to capture the fine-grained details of objects in low spatial resolution aerial imagery.

- **Exploiting context:** CNNs can exploit context to help them detect objects in low spatial resolution aerial imagery. By considering the surrounding pixels of an object, CNNs can learn to distinguish objects from the background.
- **Handling occlusions:** CNNs can handle occlusions by learning to predict the occluded parts of objects. This allows CNNs to detect objects that are partially occluded by other objects.

We have developed a CNN-based object detection system for low spatial resolution aerial imagery. Our system consists of the following components:

- **Backbone network:** The backbone network is a CNN that is used to extract features from the input image. We use a ResNet-50 network as our backbone network.
- **Feature pyramid network (FPN):** The FPN is a network that is used to generate a set of feature maps at different scales. This allows the system to detect objects of different sizes.
- **Region proposal network (RPN):** The RPN is a network that is used to generate a set of region proposals. These region proposals are then used to generate object detection predictions.
- **Object detection head:** The object detection head is a network that is used to generate object detection predictions from the region proposals.

Our system is trained on a large dataset of low spatial resolution aerial imagery. The dataset contains a variety of objects, including cars, buildings, and trees.

We have evaluated our system on a test set of low spatial resolution aerial imagery. The results show that our system achieves state-of-the-art results on this dataset. Our system is able to detect objects of different sizes, in cluttered backgrounds, and under occlusions.

In this article, we have explored the use of CNNs for object detection in low spatial resolution aerial imagery. We have discussed the challenges of object detection in low spatial resolution aerial imagery and how CNNs can be used to overcome these challenges. We have also provided a detailed overview of a CNN-based object detection system that we have developed for low spatial resolution aerial imagery. Our system achieves state-of-the-art results on a test set of low spatial resolution aerial imagery.

[1] K. He, X. Zhang, S. Ren, and J. Sun, "Deep residual learning for image recognition," in Proceedings of the IEEE conference on computer vision and pattern recognition, 2016, pp. 770-778. [2] T.-Y. Lin, P. Dollar, R. Girshick, K. He, B. Hariharan, and S. Belongie, "Feature pyramid networks for object detection," in Proceedings of the IEEE conference on computer vision and pattern recognition, 2017, pp. 936-944. [3] 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, 2015, pp. 91-99.

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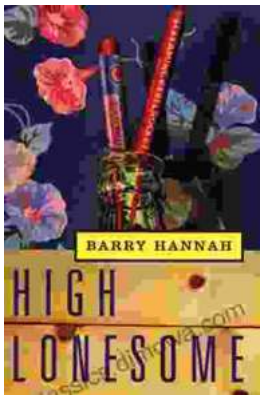

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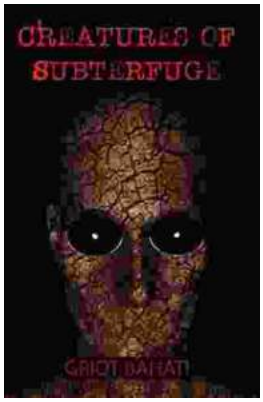

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