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الجامعـــــــة الإســــلاميـة بغـزة
كليــة تكنــولـوجيــا المعـلــومــات
قــســــم الــدراســـــات العلـيــا
تخصص تكنولـوجيــا المعلومـــات

Research:

Comparative Analysis of YOLO, Faster R-CNN, and SSD for Real-Time Object Detection in UAV Aerial Imagery for Disaster Management and Military Applications

Image Processing Course

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Research Area:

Unmanned Aerial Vehicles (UAVs) have quickly emerged as a vital asset for disaster management and military applications based on their ability to be deployed quickly, gather information quickly, and fly into hard-to-reach areas. UAVs have been employed during disaster situations to quickly evaluate the scope of the disaster, locate survivors, and deploy aid as rapidly as possible. Contained within the military realm, UAVs are excellent tools for Intelligence, Surveillance and Reconnaissance applications (ISR), which in turn provide better situational awareness and therefore better decisions. Regardless of application or context, the critical component to all of these applications is the ability to accurately detect and classify objects in aerial imagery. But, imaging from a UAV introduces some specific problem challenges—problem challenges that create a unique image acquisition problem—with challenges like varying altitudes, subject to dynamic background (varying weather) and a wide range of object scale (the size of a person appears very different relative to a vehicle, tank or building).

Title:

Comparative Analysis of YOLO, Faster R-CNN, and SSD for Real-Time Object Detection in UAV Aerial Imagery for Disaster Management and Military Applications

Abstract:

The incorporation of Unmanned Aerial Vehicles (UAVs) for disaster management and military applications has changed the way we gather information and maintain situational awareness in real time, In this context, being able to detect and classify objects in aerial imagery is paramount. This research aims to compare three state of the art, deep-learning based object detection algorithms, YOLO, Faster R-CNN and SSD. The research will explore how each of the three algorithms performs on UAV gathered aerial images for the purpose of determining the best model in terms of detection performance, time of processing and computational efforts. The results will produce an informed approach to selecting an object detection model for UAV applications in disaster management and military applications which require real-time processing.

Specific Challenges Face in Image Processing/Computer Vision:

Issue 1: Variability in Scale and Small Object Detection

Detection of small-scale objects is very difficult because the features that representation are very limited which leads to loss of detection quality. This scale ambiguity can be further confounded by altitude especially in UAV imagery.

Issue 2: Real-Time Processing Constraints on UAV Platforms

UAVs have many limitations regarding when computational resources are accessible. Achieving real-time object detection requires algorithms that are balanced between the accuracy associated with the use of deep learning neural networks and the computational elements.

Proposed Research Plan:

5.1 Literature Review

Goal:

- To Review previous studies and point out gaps

Tasks:

- Review of Yolo, R-CNN and SSD studies to detect drone-based aircraft creatures.

Outcome:

- A Clearly understanding previous methods and what to explore.

5.2 Dataset Selection & Preparation:

Goal:

- To Collect and preprocess aerial imagery datasets.

Tasks:

- Utilize public datasets (e.g., VisDrone, UAVDT), annotate the data, use augmentation methods.

Outcome:

- A well-prepared data-set of Period Finds Results for

5.3 Algorithms Implementation

Goal:

- Implement and configure YOLO, Faster R-CNN, and SSD.

Tasks:

- Implement models using TensorFlow/PyTorch, set parameters for comparability, and apply transfer learning.

Outcome:

- Three trained models ready for evaluation.

5.4 Model Traning and Evaluation

Goal:

- Train and evaluate models' accuracy.

Tasks:

- Train models using early stopping and learning rate scheduling, determine mAP, precision recall, and inference time.

Outcome:

- Performance metrics for comparison.

5.5 Analysis and Interpretation

Goal:

- To Compare and interpret model results.

Tasks:

- Discuss the benefits of speed vs. accuracy, suggest areas for improvement, consider suitability for disaster vs military application.

Outcome:

- Suggestions for the best algorithm for article and UAV based object detection.

5.6 Conclusion and Future Work

Goal:

- To Summarise findings and suggest future research.

Tasks:

- Outline potential practical applications, suggest optimizations for edge computing, suggest hybrid-models.

Outcome:

- A research roadmap for UAV model-based object detection improvements.

Related Papers:

1) ["RGDiNet: Efficient Onboard Object Detection with Faster R-CNN for UAVs"]

   The study presents RGDiNet, a system for detecting objects onboard the UAV, based on Faster R-CNN which utilizes both RGB and depth features, with the goal of better real-time performance while onboard a UAV.

2) "SOD-YOLO: Small-Object-Detection Algorithm Based on Improved YOLOv8 for UAV Aerial Photography Scenarios"
   The study introduces SOD-YOLO, a new approach based on YOLOv8 that improves small object detection in UAV imagery for researchers in disaster and military scenarios.

3) "PS-YOLO: A Lighter and Faster Network for UAV Object Detection"
   PS-YOLO presents a lightweight and computationally inexpensive way to achieve object detection on UAVs and maximizes object detection performance.

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Statement: In preparing this report, and in the exactly proposed research plan section, the author used the artificial intelligence tool to improve texts. After using this tool, the author reviewed and edited the content according to the necessity and takes full responsibility for the content of the report.