APPLICATION OF COMPUTER VISION FOR UAV DETECTION USING THE YOLO MODEL

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The detection of unmanned aerial vehicles (UAVs) is a complex task due to their small size, diverse shapes, and ability to fly at low altitudes, which often makes them difficult to detect using conventional surveillance methods such as radar or infrared detection. Additionally, drones may be equipped with technologies that allow them to bypass traditional monitoring systems, for example by emitting weak or nature-like signals that complicate detection. Challenges also arise when operating in low-light conditions or during adverse weather.

Computer vision [1] is one of the most widely used approaches for drone detection, combining the tasks of classification (assigning a label or category to an entire image or a specific region within it) and localization (determining the position of the object within the image or video and pointing to it by identifying a bounding box).

The YOLO (You Only Look Once) model is an optimal choice for creating a drone detection model, as it provides high detection accuracy, moderate computational requirements, and is capable of real-time operation. The training process of the YOLO model follows typical machine learning steps, including:

1) data collection – gathering images of drones from different angles, under various lighting conditions, and with diverse backgrounds;
2) data preparation and annotation – adding bounding boxes to indicate the positions of drones within the images;
3) model selection and training – choosing the model architecture and training parameters;
4) model evaluation – testing the model's accuracy and performance on a validation or test dataset;
5) model fine-tuning – adjusting weight coefficients and hyperparameters to achieve the desired results;
6) model deployment – integrating the trained model into a software component for practical use.

The model can be further improved by adding more training data, testing in real conditions, and optimizing for low-power devices until it reaches sufficient performance to be used in real life scenarios in different areas such as security, monitoring, or emergency response. Another important aspect is reducing false positives, especially when drones must be distinguished from birds, planes, or other flying objects in the scene. This requires careful training data preparation and potentially the integration of temporal information from video sequences.

References:

1. Szeliski, Richard. Computer vision: algorithms and applications. Springer Nature, 2022.– 910p.