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ADVANCING PALM TREE MONITORING IN THE UAE: BENCHMARK DATASET DEMONSTRATION WITH AI TECHNIQUES

Abstract

Autonomous detection and counting of palm trees is a research field of interest to various countries around the world, including the UAE. All palm trees are counted and monitored manually; a daunting task that requires tremendous time and effort. Recently, the UAE has been prospering in remote sensing technologies, which introduces the opportunity to combine space technology with agriculture to monitor the palm trees in the UAE. Automating this task saves effort and resources by minimizing human intervention and reducing potential errors in counting.

This research work introduces a High Resolution remote sensing dataset for autonomous detection of palm trees in the UAE. The dataset is collected using Unmanned Aerial Vehicles (UAV) covering various areas within UAE including Sharjah, Ajman, Dubai, Khorfakkan, and Al-Ain. The dataset contains samples that range from simple cases to more complicated ones. For instance, certain images depict palm trees that are spaced apart neatly, whereas others show palm trees that are densely packed and overlapping. Moreover, some images feature minimal shadows around the palm trees, in contrast to others that display intense shadows enveloping each tree. Furthermore, while some images exclusively showcase palm trees, others incorporate a mix of palm trees and other types of vegetation. The dataset also features palm trees in different sizes in order to make the samples as comprehensive as possible.

The images are labeled in PASCAL VOC and YOLO formats after pre-processing and visually inspecting their quality. Two Convolutional Neural Networks (CNNs) are tested on the dataset to observe their performance, advantages, and shortcomings. A comparative evaluation between YOLOv4 and transformer-based networks is then conducted to observe the usability of the dataset in addition to the strengths and weaknesses of each methodology. Both architectures are evaluated according to four quantitative metrics; Average Accuracy (AA), Average Precision (AP), Average Recall (AR), Average F-score (AF). The model's output gets seamlessly merged into a Geographic Information System (GIS) through the exportation of predictions in "shapefile" format. This geospatial vector data format precisely encapsulates the geographic coordinates corresponding to each palm tree.