



ABSTRACT

Automated Wildlife Species Detection and Classification in Oman's Natural Reserves Using Few-Shot Learning

Ethar Tamimi, Malak Abdul Hamid Al Hinai, Iman Said Al Hajri.

Supervisor: Dr. Abdelhamid Abdessalem

Sultan Qaboos University, Oman.

Background: Wildlife monitoring is a critical component of biodiversity conservation, especially in regions like Oman, where ecological challenges and human-induced threats endanger various species. Camera traps have become invaluable tools for capturing wildlife activity, producing large volumes of image data over time. However, manually analyzing these images is labor-intensive, time-consuming, and prone to human error. Accurate species detection and recognition are essential for informing effective conservation strategies, yet traditional methods of reviewing images present limitations.

In response, advances in artificial intelligence (AI), particularly in computer vision, offer efficient alternatives. Object detection models along with deep learning-based classification techniques have shown success in global wildlife monitoring initiatives. However, no work has applied these technologies to Omani wildlife specifically. This project aims to fill that gap by developing a system capable of automatically detecting and classifying animals in camera trap images collected from Omani reserves.

This study aims to:

1. Develop a prototype to detect and classify wildlife species in Oman's reserves using camera trap images, as the first AI model tailored for Omani wildlife.



2. Apply Few-Shot Learning techniques to enable species classification using minimal labeled images.
3. Evaluate and compare the performance of Prototypical Networks, Relation Networks, and Siamese Networks on the collected dataset.

Methods: This study utilizes deep learning techniques for detecting and classifying endangered Omani wildlife species from camera trap images. The dataset includes 83 images collected from the Oman Environment Authority and online sources, targeting five animals: the Arabian Oryx, Arabian Leopard, Arabian Gazelle, Arabian Tahr, and Caracal. Images are first processed using the Mega Detector tool to remove irrelevant frames and retain those with animals. Selected images are manually reviewed and organized into support and query sets for training and testing a Few-Shot Learning (FSL) model. Three FSL approaches—Siamese Networks, Prototypical Networks, and Relation Networks—are used to classify the species based on similarity scores between query and support images.

Results: The performance of the approaches is satisfactory. The Siamese Network achieved 90.5% accuracy, the Prototypical Network 92.2%, and the Relation Network 89%. All approaches successfully distinguished Oryx, likely due to its unique shape and color. However, confusion existed between Tahr and Gazelle, and between Leopard and Caracal. The Siamese Network misclassified Tahr as Gazelle; the other two misclassified Gazelle as Tahr. The Relation Network classified Tahr with 100% accuracy. All approaches confused Leopard with Caracal, which was expected due to visual similarities. Prototypical Networks achieved the best overall performance with 92% accuracy.

Conclusions: This study developed a two-stage system for automating wildlife species monitoring in Oman's reserves. The first stage used the YOLO-based Mega Detector to filter images into broad classes (Animal, Human, Other), reducing irrelevant data. The second stage used Few-Shot Learning models for species-level classification, addressing the challenge of limited labeled data. Prototypical Networks achieved the highest accuracy, followed by Relation



PalStudent Journal
A Palestinian Scientific Journal for the Youth



and Siamese Networks. This study successfully built the first AI-based system for detecting and classifying Omani wildlife species.

PalStudent Journal

Correspondence concerning this article should be addressed to the mentioned authors at the mentioned institutes.

Copyright © 2025 Al-Quds University, Deanship of Scientific Research. All rights reserved.

E-mail: research@admin.alquds.edu

Palestine, Abu Dis, Al-Quds University