

# Advancing Primate Behavior Analysis: Developing a Unified Dataset and Multi-Instance Object Tracking System for Japanese Macaques and Broader Primate Species

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## Abstract

Understanding primate behavior is essential for insights into human evolution, social dynamics, and conservation. Despite their importance, primate behavior studies lack a unified, comprehensive dataset for computer vision analysis, impeding automated tracking and analysis in natural habitats. Our research addresses this by developing a multi-instance object tracking system, initially for Japanese macaques, with plans to expand to other primates, and constructing a new unified dataset for primate research.

We developed a monkey detection model using the You Only Look Once (YOLOv4) framework. This involved improving accuracy through techniques like transfer learning, curriculum learning, and leveraging dataset heterogeneity. Our model integrates YOLOv4 with a spatial attention module and Mish activation function, achieving a mean AP50 of 96.59%, precision of 93%, recall of 96%, and mean IOU(AP50) of 77.2%. This system proved effective in animal behavior studies, reaching a 91.35% MOTA even with a heterogeneous dataset.

Building on this, we are expanding our scope to the broader category of primates, not limited to Japanese macaques. This includes collecting, distilling, and unifying diverse datasets, along with developing tailored preprocessing tools. Consequently, we've assembled a comprehensive dataset for up to 60 monkey species, featuring 234,294 images with 307,554 annotations, marking a significant advancement in primate monitoring and behavioral analysis through computer vision.