

Great Ape Facial Recognition: A Dataset & Application for Facial Recognition of Individual Gorillas in Zoo Environments

Otto Brookes, Tilo Burghardt

bristol.ac.uk

25th ICPR 2020: Visual Observation & Analysis of Vertebrate & Insect Behaviour

Introduction

- What is our motivation?
- How can artificial intelligence help?
- What is our contribution?
 - a dataset for great apes in zoo environments
 - a deep learning pipeline for facial recognition

Related Work



An automated chimpanzee identification system using face detection and recognition. EURASIP Journal on Image and Video Processing 2013. Alexander Loos & Andreas Ernst.

Chimpanzee Faces in the Wild: Log-Euclidean CNNs for Predicting Identities and Attributes of Primates. German Conference on Pattern Recognition 2016. Freytag et al.

Related Work



Towards automated visual monitoring of individual gorillas in the wild. Proceedings of the IEEE International Conference on Computer Vision 2017. Brust et al.

Chimpanzee face recognition from videos in the wild using deep learning. Science Advances 2019. Schofield et al.

Facial Recognition Pipeline: Overview

Project phases

- 1) Dataset generation
- 2) Single-frame identification
- 3) Multi-frame identification



BristolGorillas2020 Dataset

BristolGorillas2020: The Troop



The Lowland Gorilla Troop. The figure depicts row-by-row left-to-right: Kukuena, Jock, Ayana, Kera, Afia, Kala. The large image on the far right is of Touni with baby Ayana.

BristolGorillas2020: Dataset Generation

- Four cameras were placed near enrichment devices in the gorilla enclosure.
- Each data collection session recorded 2 hours of footage and took place twice per week over 6 weeks.
- Front facial images were extracted from the footage and manually labelled



Camera-housing Modules. Four modules were designed and fitted with a camera.



Gorilla face annotation. A collection of images annotated with front facial bounding boxes.

BristolGorillas2020

- Total images: 5,428
- Total video segments: 628



Training Test

The Complete Dataset. The chart shows the total number of collected images, including the number of training and test images for each gorilla

• YOLOv3 is trained to perform both localisation and classification simultaneously.



YOLOv3: Feature Pyramid-like detection network of YOLOv3 preceded by a truncated representation of the Darknet 53 feature extractor

• Mean average precision (mAP): 92.07%

Gorilla	AP (%)	Precision (%)	Recall (%)
Afia	91.30	85.0	87.0
Ayana	74.94	84.0	68.0
Jock	98.45	98.0	92.0
Kala	92.69	95.0	89.0
Kera	97.24	96.0	92.0
Kukuena	92.95	89.0	88.0
Touni	96.91	90.0	95.0
Mean	92.07 (± 8.02)	91.00 (± 5.48)	87.3 (± 9.94)



Individual gorilla performance. the average precision (AP), precision and recall values for each individual member of the troop using the optimal weights on the holdout set.

Mischievous Afia. Eating fruit in the greenery..



Prediction vs. Ground-Truth Bounding Boxes. The figure shows examples of ground-truth bounding boxes (red) and predicted bounding boxes (green) for Touni (left), Kera (middle) and Kukuena (right).

Multi-frame Identification

Multi-frame Identification

- In Phase 2 the network is applied to individual frames
- All detections are fed into a simple algorithm that associates detections
- The resulting associated frames represent tracklets



Multi-Frame Recognition. The figure exemplifies a 3-frame tracklet and shows confidence scores for the dominant class, Kala

Multi-frame Identification

- For each tracklet we evaluate identity classification via **maximum** and **average** voting
- Multi-frame detection results:
 - W/ maximum voting: 97.49% mAP
 - W/ average voting: 97.28% mAP

Performance Metric	Single-Frame	Average Voting	Maximum Voting
mAP (%)	92.1	97.28	97.49
Mean Precision (%)	91.0	95.13	95.40
Mean Recall (%)	87.3	91.11	91.20

Multi-frame detection. Results achieved by the multi-frame approach using the average and maximum voting schemes

Summary & Conclusion

- •The BristolGorillas2020 dataset can be used to enhance great ape research
- •YOLOv3 can be trained to perform robust identification of individual great apes

Future Work

- Training our system on other great ape datasets for comparison
- Install our system as a permanent feature at Bristol Zoo

Thanks for listening!