Sandia National Laboratories

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Species Identification for Rangeland Management

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Abstract

Automated rangeland management is a difficult but necessary task. NM small business Wildlife Protection Management[1] partnered with our team through the New Mexico Small Business Assistance program[2] seeking a way to distinguish individual horses present in video data. Our team was able to show that by retraining current deep neural network object detection architectures on their data we could reliably distinguish between horses and cows even when the animals were partially obscured. Furthermore, the single frame detections were temporally reliable enough to feed into a simple centroid tracker which enabled distinguishing individual horses across the runtime of a video.

Object Detection

We chose Faster R-CNN[3] for our network architecture due to its ability to run on individual frames. The network was initially trained on the COCO dataset[4] then transfer learned with data provided by WPM. Ground truth for the WPM data was generated manually.

After retraining with the WPM data, as well as limiting the number of output classes, the network was able to produce detections as seen in figure 1. The percentages given are the internal network's confidence values. The network was able to successfully identify animals in a range of challenging lighting and pose situations.

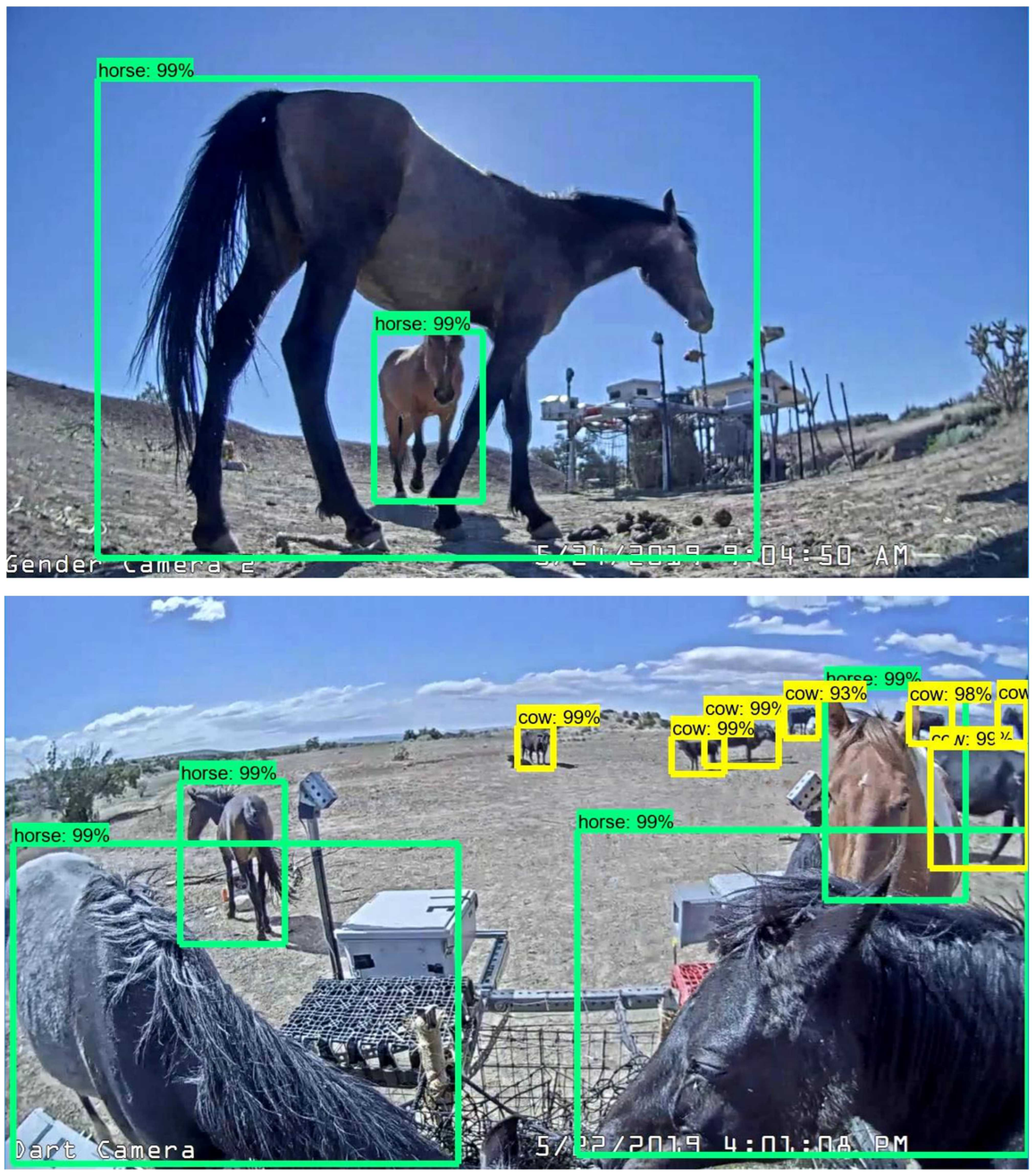


Figure 1: *Top*: The network can distinguish the two horse even though their bounding boxes overlap entirely. *Bottom*: The network is able to perform well even with extreme variation in scale and amount of occlusion.

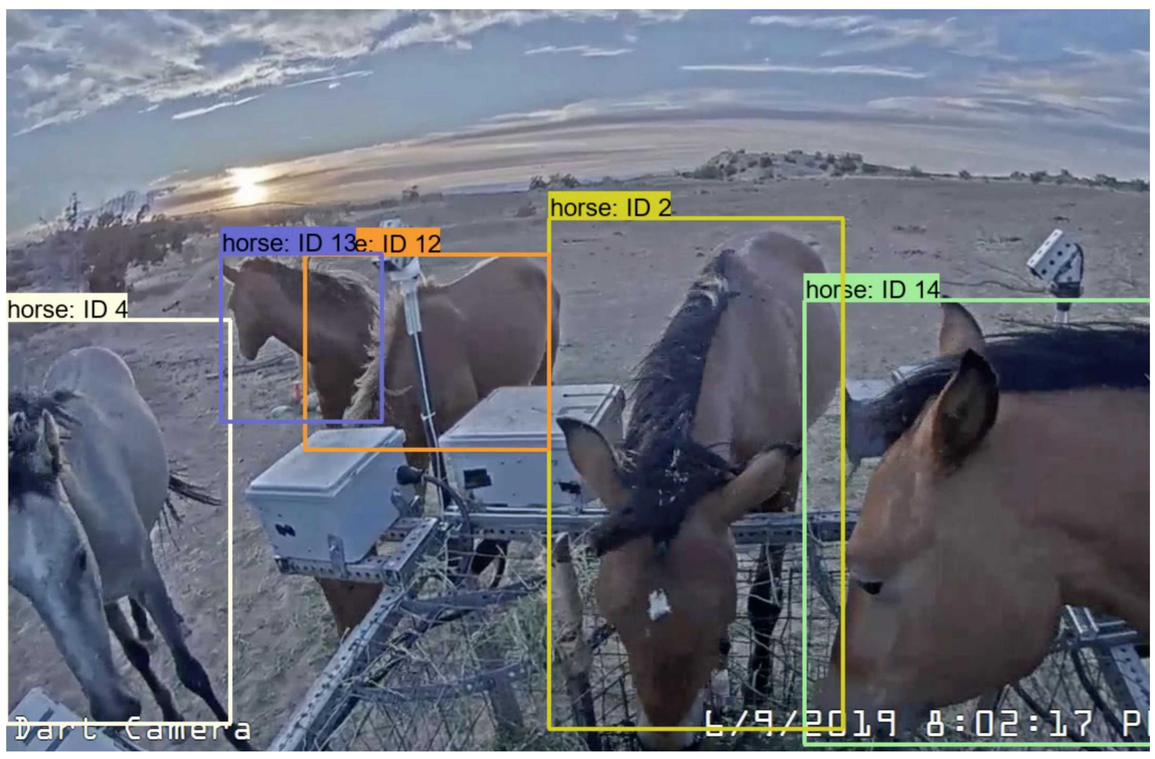


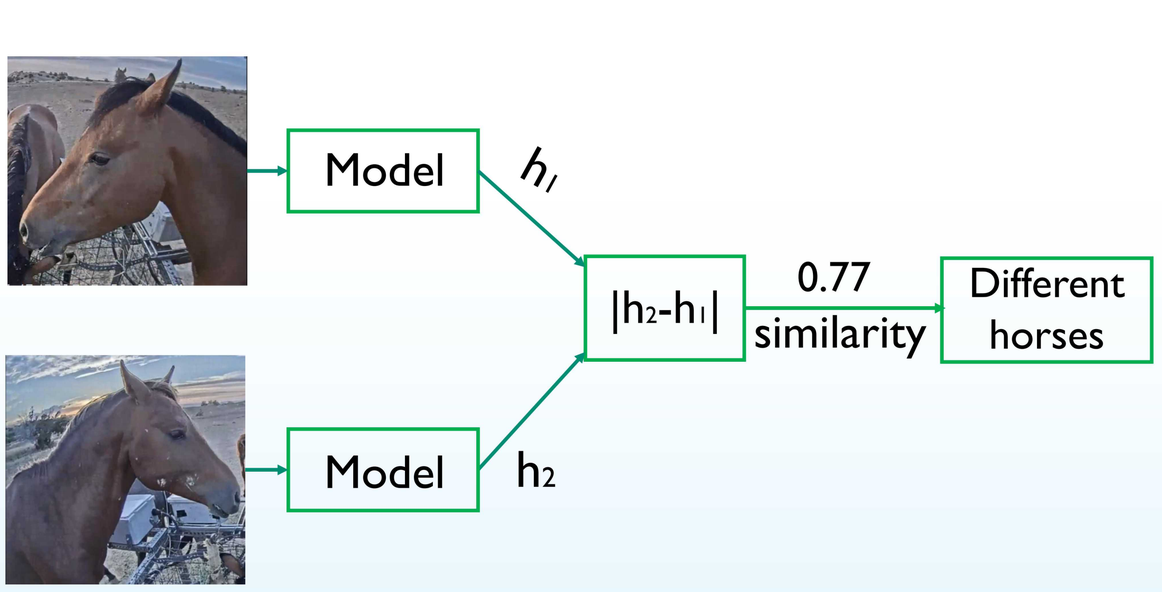
Figure 2: Horses labeled with tracker output. Horses 12 and 13 are able to be distinguished despite their close proximity and similar coloring.

Object Tracking

The WPM data consists of videos of varying lengths. After processing a video frame with the Faster R-CNN network we feed the resulting bounding boxes into a simple nearest neighbor tracker. Stable tracks are then used to identify a given horse throughout a video collect. Detections are allowed to lapse for several frames to account for brief occlusions when a horse walks behind an object or another horse.

Re-Identification

The next step is to develop a model capable of horse identification. The model will take as input a horse detection, and calculate a similarity score between the image and other horse images in a database. Horses are then classified as identical if the score surpasses a given threshold. Methods we are currently exploring include Siamese networks and triplet loss.



[1] Wildlife Protection Management – https://wildlifepm.com
[2] New Mexico Small Business Assistance – https://www.nmsbaprogram.org
[3] S. Ren, K. He, R. Girshick, and J. Sun, "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks", 2016
[4] COCO – Common Objects in Context – http://cocodataset.org

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