



Eagle Image Classification

For Hawk Watch International (HWI)




HWI Problem Statement

- HWI is measuring eagle behavior while the eagles feed on carcasses near roads
- Motion triggered game cameras record eagle behavior for later analysis
- HWI has a backlog of about 1 million images needing to be analyzed
- **Low signal to noise ratio**
 - 5% eagles (50,000 eagles in 1,000,000 images)



Specification for Eagle Image Classifier

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- ▶ Automate finding the eagles in the 1 million image backlog
 - ▶ Provide low false negative rate to ensure no eagle data is lost
 - ▶ Tune in favor of allowing false positives
 - ▶ Produce a list of image ranges containing eagles for each image set



Constraint

- The solution must run on a laptop. More powerful computing resources are not available to HWI at this time.
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Example Image

➤ Metadata

- Datetime stamp
- Sequence number / Sequence length
- Camera number



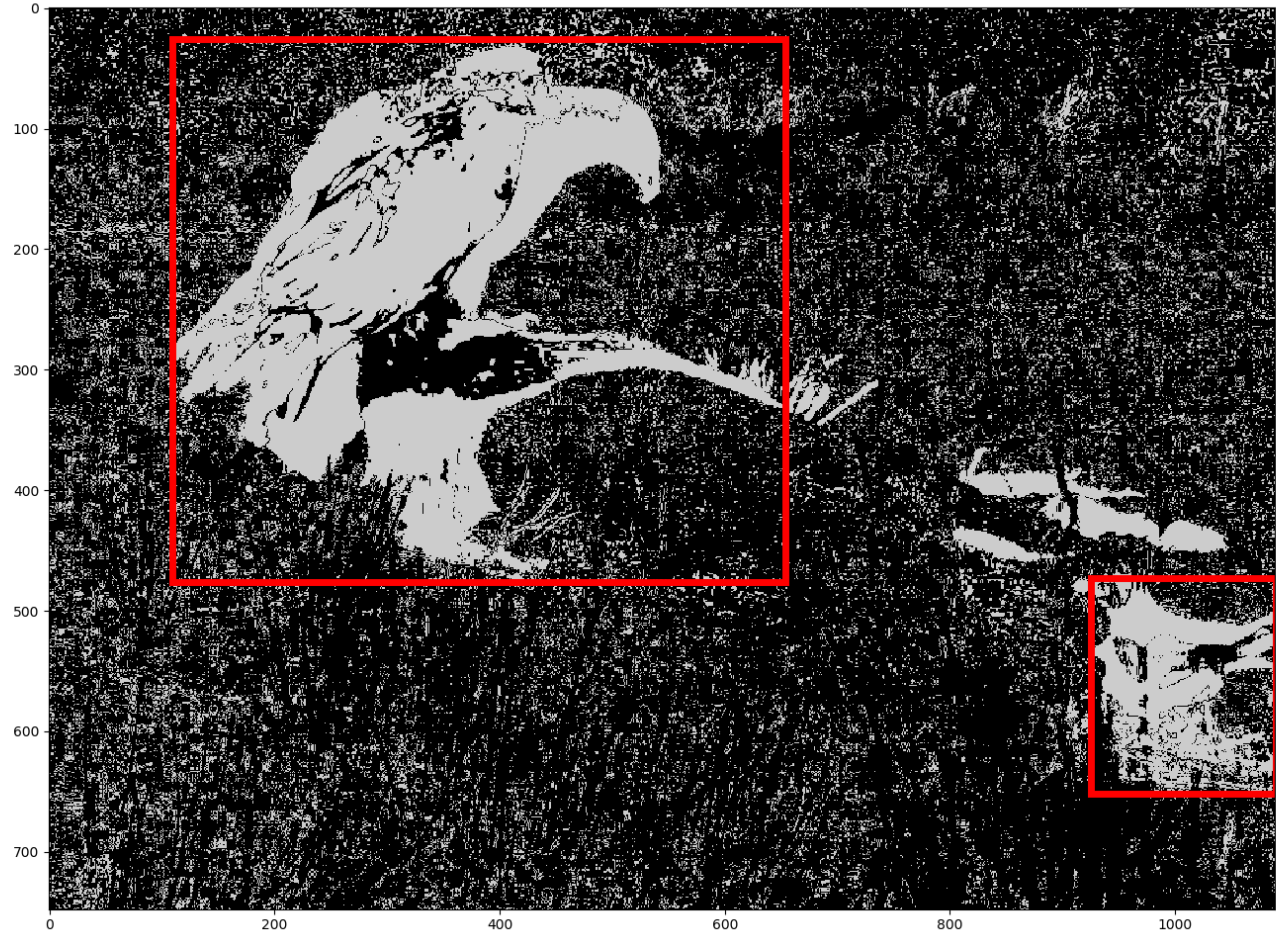
Image Variation

- Distance from camera to carcass
- Shadows
- Clouds
- Lighting varies with position of sun
- Plants such as grass and sagebrush
- Scavengers such as magpies, ravens, dogs, etc.
- Cars and trucks
- Carcass size (elk, cow, deer, jackrabbit, racoon, skunk)



Approach

- User selects ROI
- Subtract images in a sequence to capture moving objects
- Use morphology to calculate bounded boxes (bboxes) around moving objects
- Filter to keep large moving objects






Feature Set



- Area: filled area in bbox normalized to median filled area for the run
- Aggregate statistics: mean, standard deviation, skewness of original image intensity in bbox
- Hu invariant moments for original image intensity in bbox



Best Results So Far

- ▶ 65% recall: 65% of the images with eagles predicted correctly
 - ▶ THIS IS NOT GOOD ENOUGH. Eagle data would be lost.
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Next Steps

- Improve the training set
 - Visualize the data once again to look for correlations that may have been missed
 - Explore additional feature engineering
 - Recommend HWI obtain supercomputer resources in order to use neural network machine learning algorithms
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