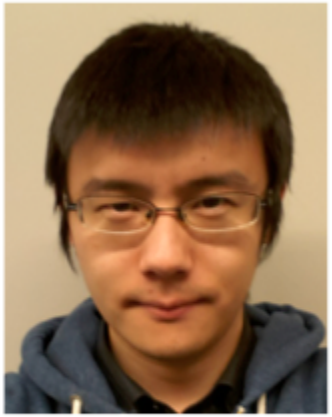
Object detection in Lake



Shijie Li

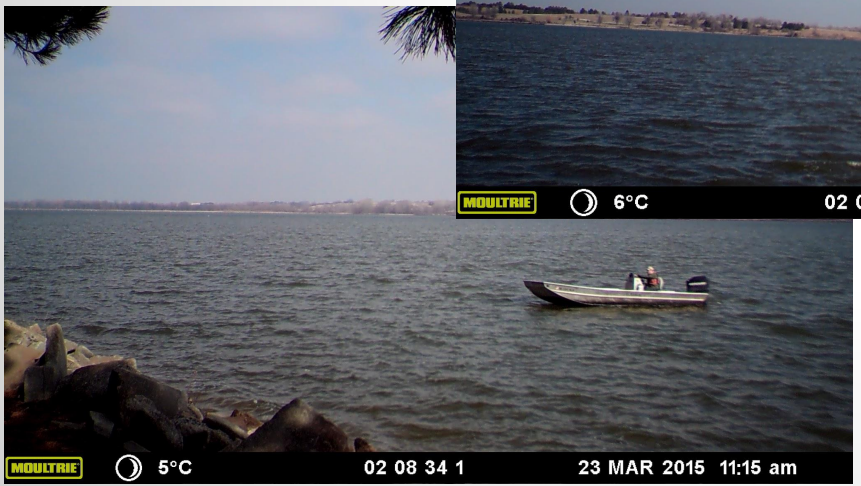
Lichao Sun

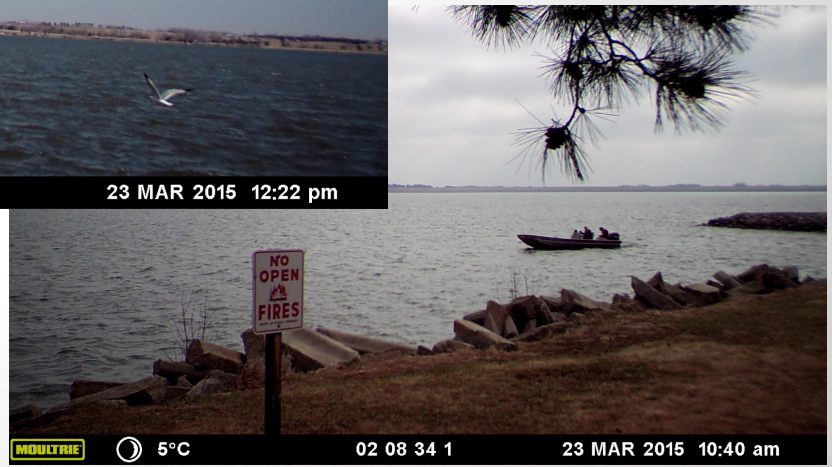
William Wells

Getting Started

Our data set was developed by Brian Harmon.

374 images
2 separate cameras
3 locations per camera





Purpose: assist in the study of

Angler Behavior in Response to Management Actions on Nebraska Reservoirs

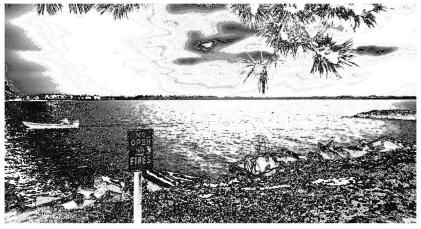
Natural resource agencies invest substantial resources to recruit anglers.
Researchers GOALS: To
1) understand the participation patterns of anglers on local and regional scales
2) understand how participation patterns of anglers influence fish populations.

Detection Process

Cropping
Mean Shift Segmentation
Canny Edge Detection
Sliding Window Search

Original Image

Cropped Image


Mean Shift Segmentation


Canny Edge Detection


Sliding Window Search

Results

Failure Cases

Peninsula

Lake: Waves

Land

Detecting Non-Boats

Sign

Bird

Boat or Bird?

Why we do this?

Machine Learning

Machine learning is a good way to classify different objects.

Key to get the features:
Bag of features
http://www.mathworks.com/help/vision/examples/image-category-classification-using-bag-of-features.html?refresh=true

Get Data for Classification

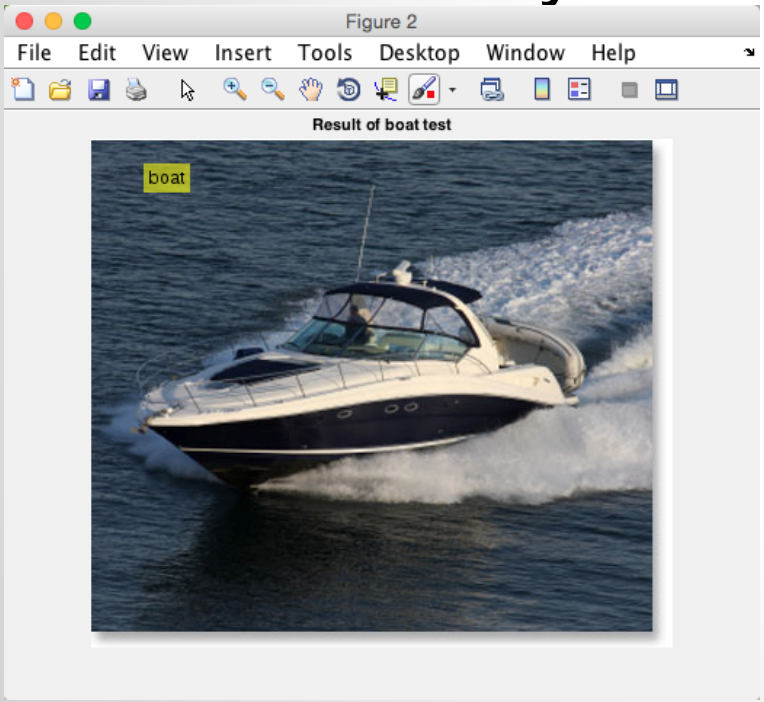
Here I download 39 images for each bird and boat category.
Since different images are different sizes.
Large images took too much time to train them.
Solution: imchange.m <=set all images to one size in a directory

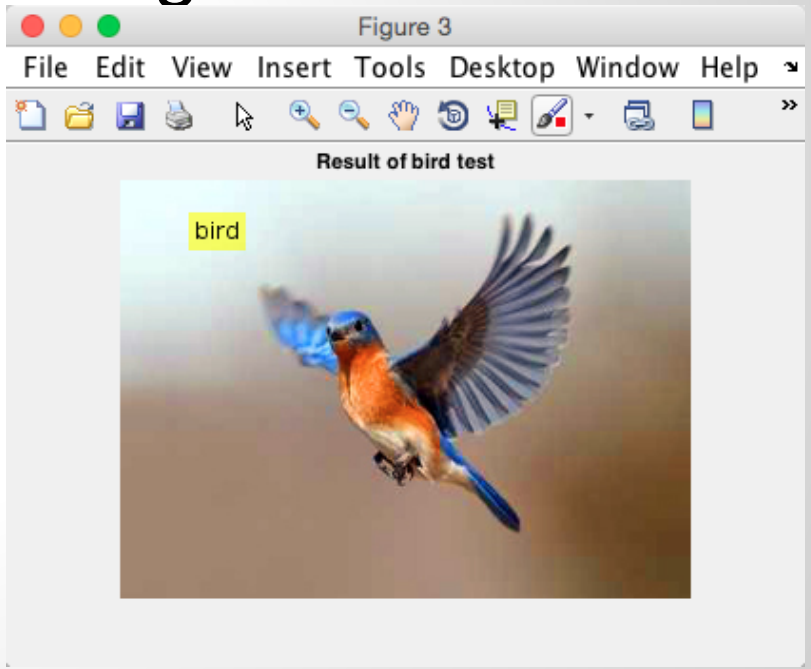
Classification Process

Load images
Set images sets
Set the training set size & testing set size
Get the features through bagofFeatures
Train the images by SVM
test and evaluate the result

Testing Examples

100% Accuracy from 4 new images





Result

Here are the results for test sets.

```
* The confusion matrix for this test set is:

            PREDICTED
KNOWN    | bird   boat
-------------------------
bird     | 0.81   0.19
boat     | 0.00   1.00

* Average Accuracy is 0.91.
```

```
* The confusion matrix for this test set is:

            PREDICTED
KNOWN    | bird   boat
-------------------------
bird     | 0.89   0.11
boat     | 0.04   0.96

* Average Accuracy is 0.93.
```

GPS Database Construction

Search the closest image location in the GPS database, due to the randomness of k-Means clustering.

Camera Label	Image Location	GPS Position

Color-based Segmentation

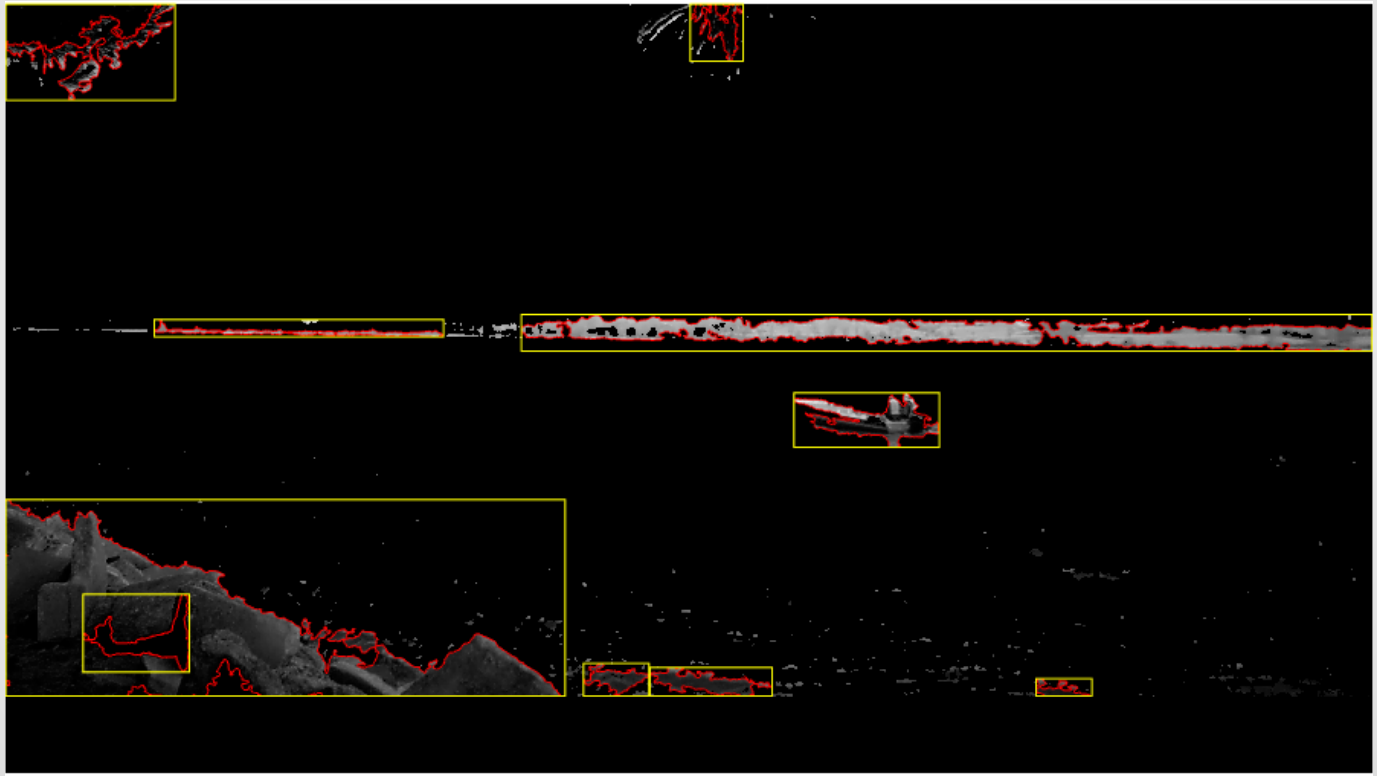
1. Convert RGB image to LAB image
2. Cluster image pixels based on colors and illumination using K-Means algorithm
3. Choose the cluster that contains the most of boat pixels based on illumination
4. Pick the segments according to the pixel connectivity
5. Return the row and column position of the segments of interest

Clustering By K-Means

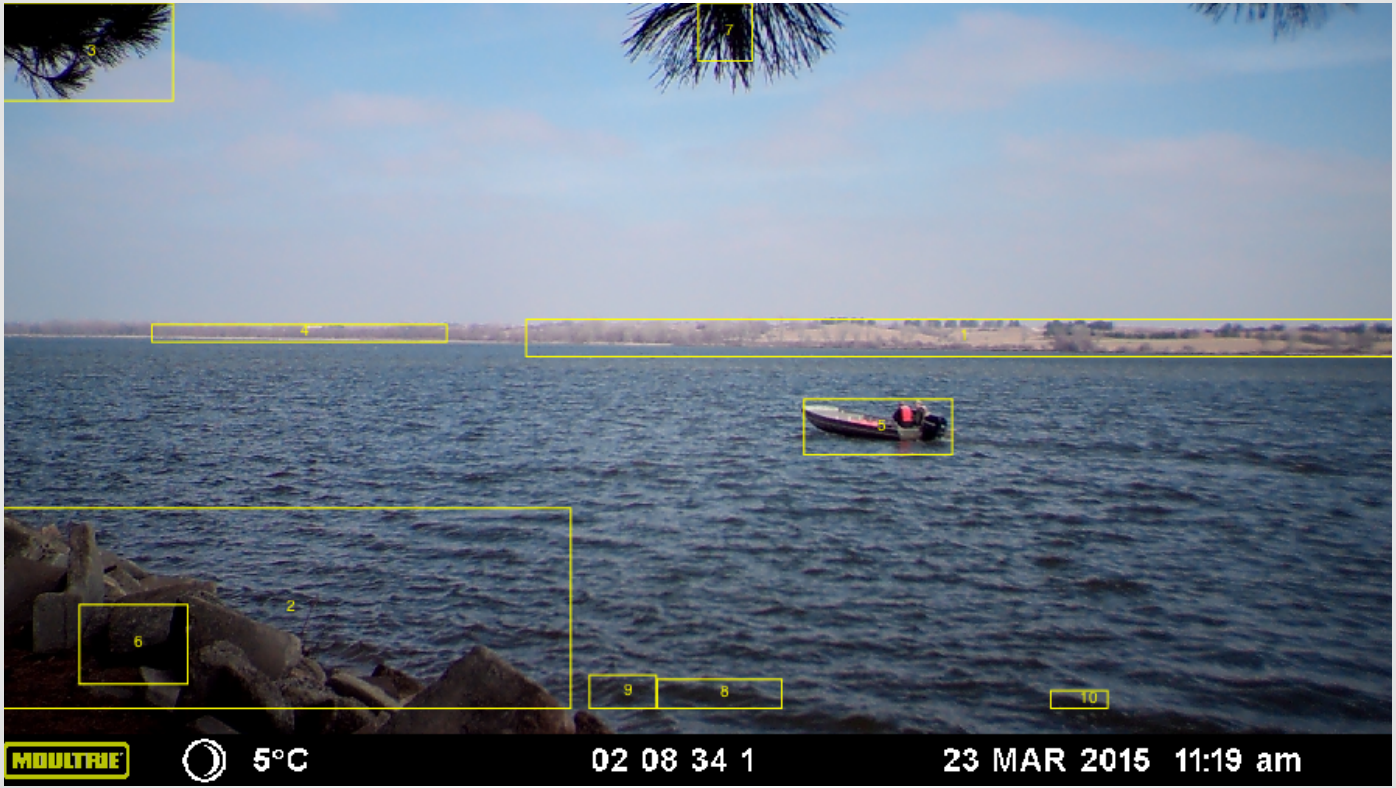
3 Clusters by Colors(0 - 255) and Illumination

Choose the cluster containing boat based on illumination

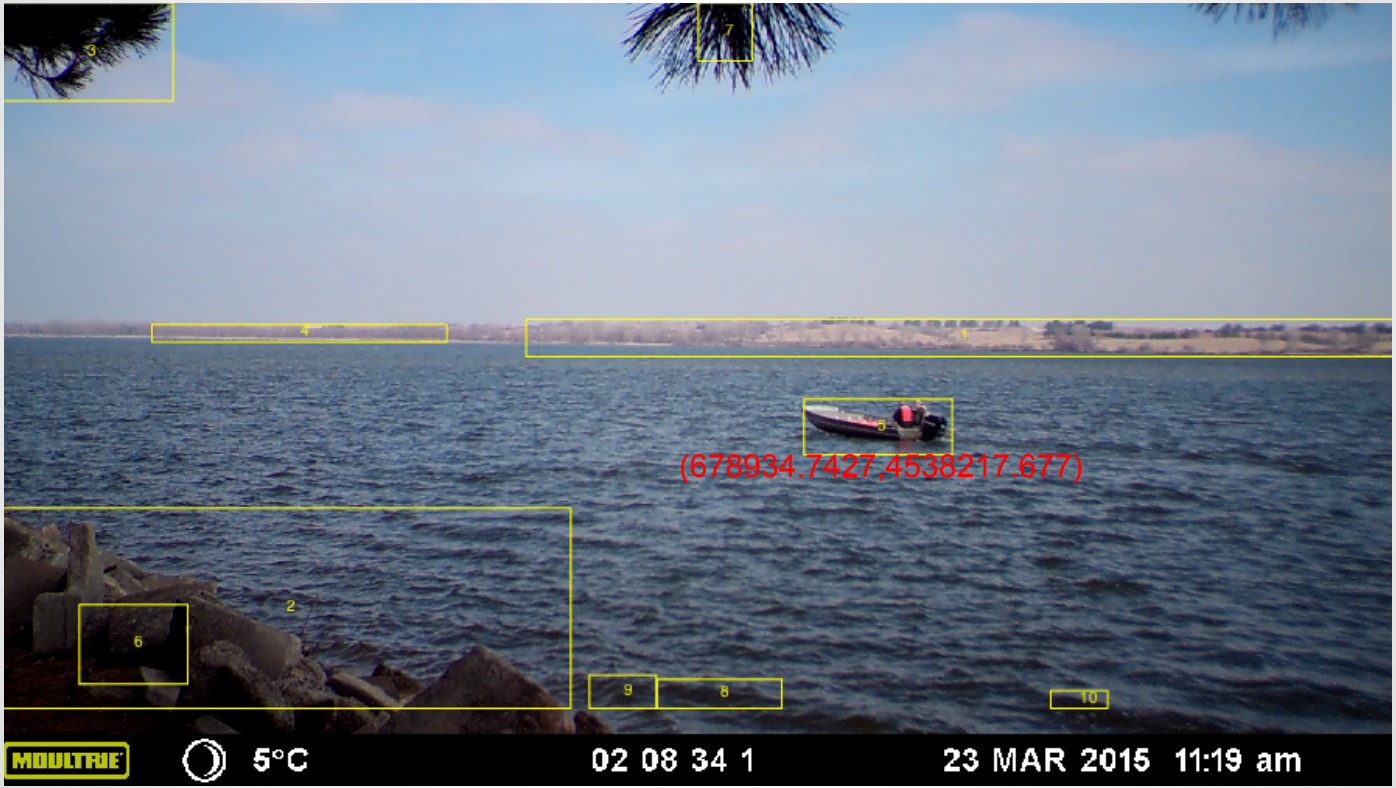
Segmentation



Segments Labeled For Recognition



Location of Boat

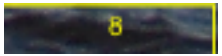


Object Recognition Difficulty

land

boat

wave



- All contain the wave features
- Land and boat are in similar colors
- Wave and boat are in similar geometry

Conclusion & Improvement

Variable increasing sliding window size as pixel depth increases
Modify existing code to search for [0,n]

For machine learning part, the best is to remove the parts which we don’t want, like the water background, and pick the boat images more close to we want to build the train set.

The recognition of boat is not accurate so far, so the location of boat is not quite reliable. We will use several methods to help improve the recognition, such as geometry and shapes.

Objects of Interest (OOI)

Segmentation Results

Original Image

Original Image With OOI