Monitoring Illegal Fishing through Image Classification

Jason Frost
jfrost@stanford.edu

Taylor Geisler
tgeisler@stanford.edu

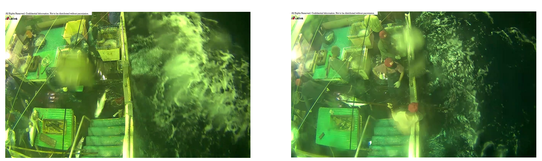
Antariksh Mahajan
am95@stanford.edu

Problem

Nature Conservancy, an NGO, monitors illegal fishing by installing cameras on fishing boats. Image classification using computers can help them to speed up and automate the process. We built a multiclass classification system for 8 different species.

Data

- **Original dataset:** 3777 images, 8 labels
- **Data preprocessing and augmentation:**
  - Feature-wise centering set input mean to 0
  - Random rotations, shifts, flips increased dataset size to >20,000 images
  - Rescaled to 224x224 for easier processing
- **Challenge:** fish are tiny part of most images



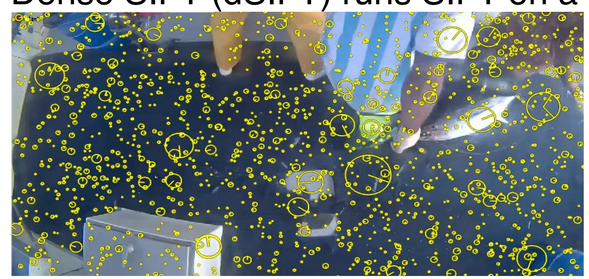
Label: ALB BET

Baseline models

- Naïve Bayes (by occurrences of colors): 8%
- 1-nearest neighbor: 97%!
- But this is because similar boats catch similar fish. Need more complex model for greater generalizability.

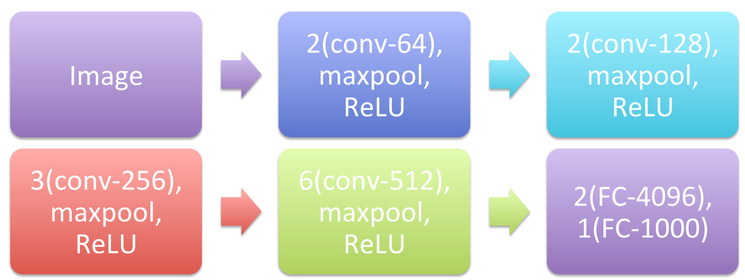
Feature Extraction

1. Scale-Invariant Feature Transform (SIFT)
   - Identifies keypoints (shapes with directional orientations)
   - Invariant to rotations and translations
   - Dense SIFT (dSIFT) runs SIFT on a grid



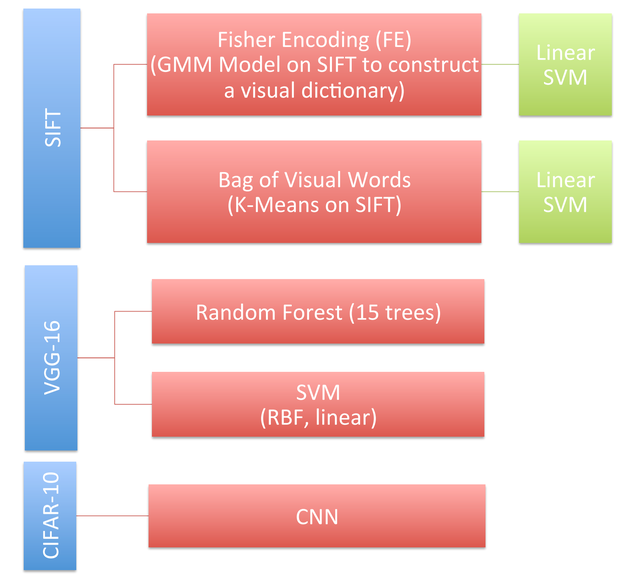
Training image with SIFT keypoints

2. VGG-16 Convolutional Neural Network
   - 16-layer CNN, has won image recognition competitions by ImageNet
   - Pre-trained weights, outputs 1000 features



3. CIFAR-10 Convolutional Neural Network
   - 10 convolutional layers
   - Trained our own weights

Modeling



Results

Extraction Method	Model	Training Acc.	Test Acc.
VGG-16	RF	99.5%	83.4%
	SVM-RBF	44.3%	45.6%
	SVM-Linear	54.1%	53.3%
-	CIFAR-10	95.6%	77.3%

Conclusions

- VGG-16 to RF performed best
- However, difficult to extract most important features from VGG-16
- Better and more generalizable results can be obtained by extracting fish from images, possibly using another CNN