Computer Vision 2023 Project

Sealife Classification and Detection

The increasing demand for marine monitoring calls for robust automated systems to support researchers in gathering information from marine ecosystems. This includes computer vision based marine organism detection and species classification systems.

Project Objectives:

1. Apply Image Enhancement/Preprocessing on the given images
2. Apply Image Classification to classify each image into the category of fish.
3. Apply object detection on the dataset and then count the number of instances of each class in an image.
4. Apply segmentation using clustering on the same dataset to separate areas of interest.
5. Bonus Tasks

Dataset Description

The full dataset can be found [here].

The dataset provided consists of the following folders/files:

1. Train Folder that contains 944 images and two annotations files ("_annotations" file has the object detection ground truth while "_classes" has the classification labels)
2. Valid Folder that contains 270 images and two annotations files ("_annotations" file has the object detection ground truth while "_classes" has the classification labels)
3. Test Folder that contains 136 images and two annotations files ("_annotations" file has the object detection ground truth while "_classes" has the classification labels)

- For classification, you could drop the images that have more than one class. Multi-label classification is the bonus.
- **Another bonus** is after applying kmeans segmentation you could get the length and width of each image from the segmentation mask.

_annotations.csv

filename	width	height	class	xmin	ymin	xmax	ymax
FishDataset285_png.rf.30b2d9af78472	416	416	Lutjanidae -Snappers-	129	103	344	293
FishDataset650_png.rf.0a14f4401f6bee	416	416	Carangidae -Jacks-	68	54	366	264
FishDataset650_png.rf.0a14f4401f6bee	416	416	Carangidae -Jacks-	214	279	415	392
FishDataset97_png.rf.0bb11163a08456	416	416	Acanthuridae -Surgeonfi	127	101	215	215
FishDataset97_png.rf.0bb11163a08456	416	416	Acanthuridae -Surgeonfi	317	226	400	337
FishDataset97_png.rf.0bb11163a08456	416	416	Acanthuridae -Surgeonfi	183	168	273	302
FishDataset97_png.rf.0bb11163a08456	416	416	Acanthuridae -Surgeonfi	97	268	164	351
FishDataset97_png.rf.0bb11163a08456	416	416	Acanthuridae -Surgeonfi	13	101	103	228
FishDataset352_png.rf.068edb9ed4ce4	416	416	Scaridae -Parrotfishes-	125	137	216	239
FishDataset382_png.rf.491ef3840d3a0	416	416	Scombridae -Tunas-	24	139	414	243
FishDataset82_png.rf.225b7131127d4d	416	416	Carangidae -Jacks-	135	72	359	222

_classes.csv

filename	Acanthuri	Balistidae	Carangida	Ephippida	Labridae -	Lutjanidae	Pomacant	Pomacent	Scaridae -	Scombrid	Serranidae	Shark -Sel	Zanclidae	Zanclidae
FishDataset232_png.rf.CC8AfGJBFvbo9JTlNPe4.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset543_png.rf.AHvCiaYI1X9R6ahBWZ39.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset723_png.rf.CJDQb76KF0RWf8IB0Yzz.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset383_png.rf.CUvJtiM0i6cxxYjUVUN3.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset701_png.rf.CwDI3bAbdszg3lr9WqyN.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset472_png.rf.BP22OzXsHavPqmLQGQm7.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset290_png.rf.AJ4SaVHHU3x9TZzXBglo.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset160_png.rf.CkO5JnAATBCw0AdEo6ac.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset331_png.rf.CluHLgv9GcGDFJQgQmgs.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FishDataset603_png.rf.9q4RfT4Y2PaLHVLHE1y3.jpg	0	0	0	0	0	0	0	0	0	0	0	0	0	0

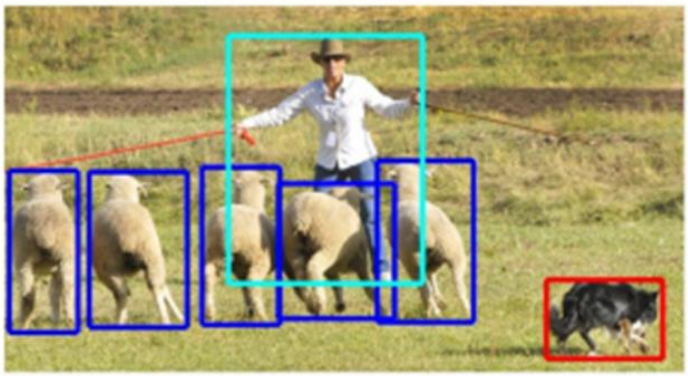
Scombrid	Serranidae	Shark -Sel	Zanclidae	Zanclidae	angel	damsel	grouper	jack	parrot	shark	snapper	spade	surgeon	trigger	tuna	wrasse	NumClass
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2
0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

- Dataset Example:

- Segmentation Requirements (Will be explained again in the segmentation lab):
  - Apply Segmentation using clustering (kmeans and mean shift) on the images in the dataset after enhancement and detection to generate pseudo segmentation masks for each object

- For example, your object detection model should generate an output as in the left image.

- Apply Kmeans or Meanshift on each bounding box independently to generate a semantic mask similar to the one generated in deep learning-based segmentation (right image)



Practical Exam Project Deliverables:

Important Note 1: If you trained the deep learning models using a notebook, you must deliver the notebook with the output cell saved displaying the training logs. If you trained the model using IDE (i.e Pycharm). **You must deliver screenshots of the training process**.

Important Note 2: You must make use of all three folders (Train, Validation and Test). For example, You cannot use train and test only

1. Apply **Image Preprocessing** on the dataset if needed (Deliver Code)
2. Apply **Image classification** to classify each image (Deliver Code)
3. Apply **object detection** on the given dataset using deep learning techniques. (Deliver Code)
4. Apply **segmentation** on the given dataset using clustering-based algorithms. *Task Requirements explained in slides of Lab 7*. (Deliver Code + Folder containing the segmentation masks for all images in the test set)

5. **Optional Bonuses**: Multi-label classification, Extract measurements of each fish after applying segmentation such as the length and width of each fish using image processing.
6. A **Report** that includes description of:
    - Your data preparation process.
    - Screenshots from the before and after Image Preprocessing if exists.
    - Brief description of the models and techniques used in each task.
    - Training and Testing times for each model.
    - Image Classification training and testing accuracy.
    - Object detection Training and Testing accuracy.
    - Screenshots of the dataset from your object detection trials.
    - Screenshots of the dataset from your segmentation trials.