International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Underwater Marine Life Detection Using Image Processing

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Abstract

Marine life research and computer technology have been utilized in tandem for the study of aquatic ecosystems and the analysis of ocean floors throughout the last few decades. Few modern solutions have been offered in this field in recent years. The work in object detection and recognition based on machine learning models have given good information about the surroundings and behavior of marine ecosystems. These models are complex in usage, they often rely on the information source from multiple data forms. The major task is to remove the high impurities in underwater images as the noise removal process is difficult. The image extraction is carried out using darknet which helps in proper object detection. Due to this, the actual applications and study of marine life is realized easily. A suitable environment will be created so that machine learning algorithms such as YOLO will be used to detect and recognize the animals under the ocean with the help of image processing.

Keywords: - Deep Learning, YoloV5, Classification, Convolutional Neural Network

I. INTRODUCTION:

Water covers more than 70% of the Earth, and our oceans play an important role for humans all over the world. It is critical to keep our oceans healthy in order to prevent biodiversity and maintain sustainable fisheries. Monitoring the impact of human activities on our water on a local, regional, and on international scale is a necessary step toward a better understanding of marine life and ecosystems. Due to research in this era the sensitive marine ecosystem could be able to flourish within proper surveillance. The primary motivation behind the efforts is to study the difficulties in ocean terrain, coral reefs, marine life, marine ecosystem and research of near extinct species. Considering the problems faced due to climate change, oil spills, the marine ecosystem has faced a lot of issues. With this motivation, the plan is to work on these problems using images and machine learning algorithms. The major challenge is to provide an impactful solution as the ocean bodies need to be focused due to their importance in nature's life cycle. Machine learning offers many functionalities due to which working on underwater images becomes simpler and result accuracy enhances to satisfactory level.

II. PROPOSED METHODOLOGY :

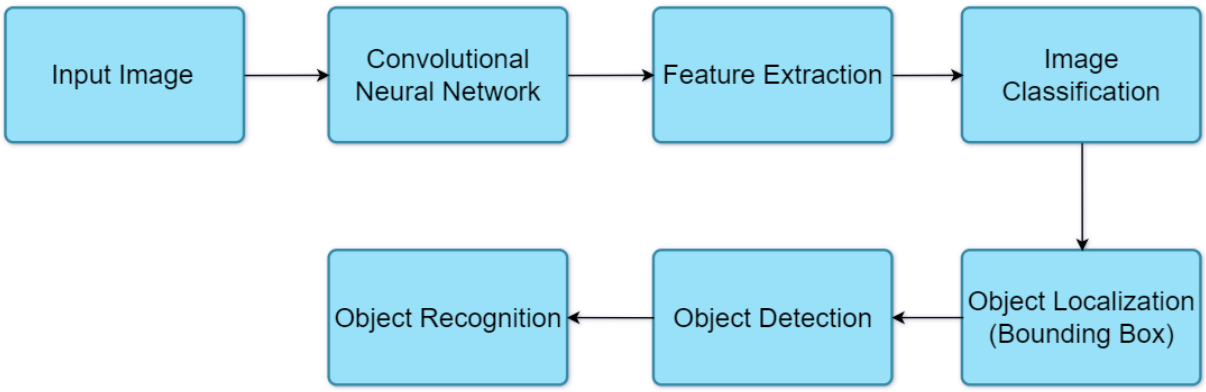

Fig.1: Block Diagram for Underwater Object Detection using YOLOv5

- Model takes Underwater Image as an input.
- **Yolov5 CNN:**
  The Yolov5 architecture consist of three parts:
  1. Backbone: Backbone is mostly used to extract useful features from images. Using CNN, it first divides the entire image into grids. Then, in YOLO, it employs Cross Stage Partial Networks as a backbone to extract useful weights from an input image.
  2. Neck: The Neck is mostly used to create feature pyramids by fusing features extracted from the backbone. When it comes to object scaling, these pyramids aid in successful detection. It aids in the recognition of the same object in different sizes and scales.
  3. Head: The Head is primarily responsible for the final detection step. It predicts final output vectors using anchor boxes, class predictive probabilities, object scores, and bounding boxes.
- **Image classification:** In this phase, the classifier in machine learning automatically orders or categorizes data into one or more of a set of "classes", Which are used for predicting probabilities.
- **Object localization:** Object localization is the technique of figuring out an example of a selected item class in a photo via way of means of cropping a tightly cropped bounding field across the example. Model predicts the magnificence for the gadgets inside the entire photo.
- **Object Detection and Recognition:** In this phase, the model predict a bounding box to find the presence of object in an image, as well as the types or classes of those objects. The model generates a list of animal classes present in the image, as well as a bounding box indicating the position and scale of each object type. Finally, marine animal identification is completed.

Results and Discussion:

1.Dataset Description:
This experimentation is performed on the Underwater Aquarium Images Dataset downloaded from Underwater Object Detection dataset from Kaggle which contains 1600 images which was divided into 1200 training,300 validation and 300 testing datasets. A laptop with Windows 10 package powered by GPU Processor of NVIDIA, Radeon, etc. and minimum RAM of 4 GB with an i5 Processor is required. The dataset is labelled and contains 7 classes namely Fish, Stingray, Shark, Puffins, Penguin, Jellyfish, Starfish.

2.Detection and Classification:
In this stage detection of marine animals were determined by training the dataset using YOLOv5 CNN. Images were selected and animals in images are labelled as Fish, Stingray, Shark, Puffins, Penguin, Jellyfish, Starfish. the aim of using all datasets together in training is to diversify training and to automatically detect all animals. The Underwater images were classified by adding the mechanism of pretrained CNN models (Yolo).

3.Performance Evaluation supported Accuracy:
The concept of Intersection over Union (IoU) is used for object detection. IoU is the ratio of the common area between the ground truth and predicted bounding boxes to the union of both bounding boxes. An IoU of 1 indicates that the predicted and thus ground-truth bounding boxes perfectly overlap. In this case, the IoU is set to 0.5.

1. If the IoU is less than 0.5, classify the object detection as True Positive (TP)
2. If Iou is less than 0.5, the detection is incorrect and should be classified as False Positive (FP)
3.When a ground truth is present in the image but the model does not detect it, classify it as False Negative (FN)
4.True Negative (TN): A TN is any part of an image where the model failed to predict an object. Because this metric isn't useful for object detection, it should be ignored.

Precision= True Positive/ (True Positive + False Positive)
Recall=True Positive/ (True Positive + False Negative)

mAp is average of all precision.
The accuracy of model can be calculated on basis of mAp (mean average precision). The mAp of model is 0.89. This Shows that yolo model is accurate and fast than the previous versions of yolo as well as faster RCNN model.

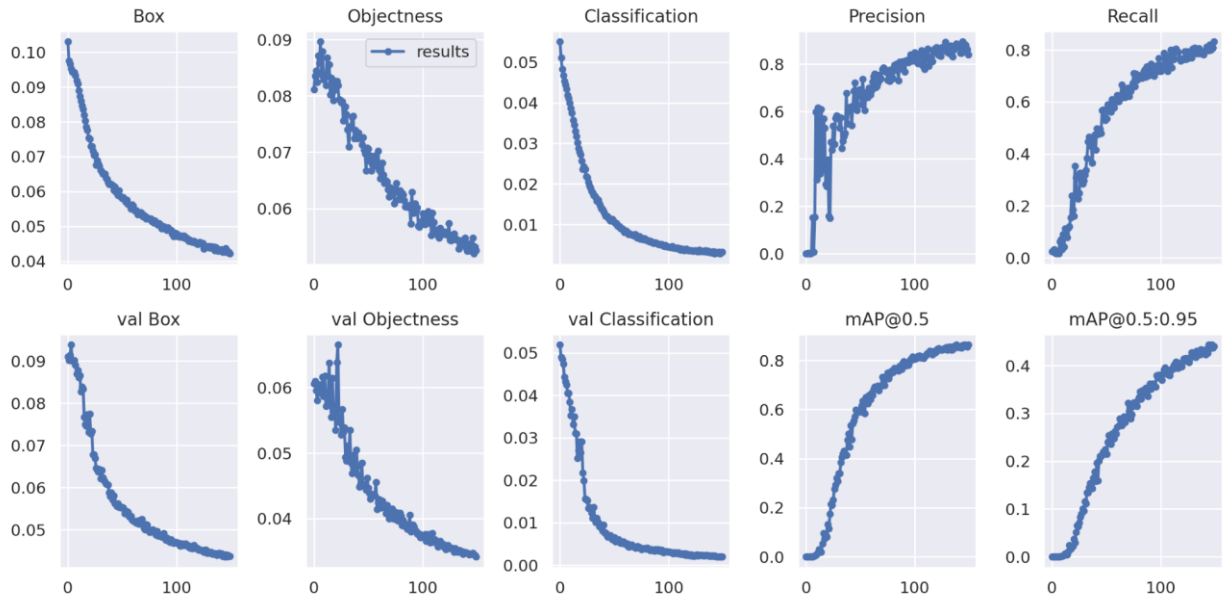

Fig. Training and Testing Accuracy based on mAP

Conclusion-

Although little progress has been made in the study of marine ecosystems using machine learning, tasks such as detecting an object, action classification, object recognition, and spatial features of an object are possible to study; however, identifying a single or multiple objects at the same time underwater is relatively difficult. To achieve this goal, images should be captured in real time and expressed as a high dimensional image based on semantics in order to express them in the desired form of the ecosystem. It has a significant impact on the real world because it allows us to properly monitor and study the life of marine ecosystems. YOLO will be used to create our object detection and recognition model. Object detection from current data is carried out using the YOLO Single stage detection algorithm. Once the image has been properly formatted, it is ready for further recognition modeling.

Future Work :

The improvement we are attempting in this project is to test adding our own custom trained dataset to the model rather than using the default one. Also the current model can only detect the specific animals such as

sharks, fishes, stingray, jellyfish, penguin, starfish, puffins in Future the model will be able to detect all types of marine animals by training with proper dataset.

Application :

Underwater Object Detection is an important tool for the nautical examination and submarine possibilities over the extent of swath. Also the underwater object detection techniques can be used to check the abundance of marine animals or also animals from the ocean which are on verge of extinction. And necessary steps for preserving these animals can be taken. Also the system can also be used for marine litter or garbage detection in ocean terrain.

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