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DETECTION AND EXTRACTION OF SEA MINE FEATURES USING CNN ARCHITECTURE

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Abstract

The Conventional worry of navel asset is naval mines; these mines are stationary and were planted during war times and now they have been working as a threat to naval ships, and submarines. Detection of those naval mines has been one of the foremost risk-taking tasks, with modern technology various techniques are wont to detect these mines Using Ultrasonic signals, Symbolic pattern analysis of side-scan sonar images but detection through image processing has been one of the most challenging and efficient ones since it can solve the real-time problem with less error, the image classification model like uses FRCNN(Fast Region Convolutional Neural Network) algorithm to classify the objects as mine or not. The cloud platform is employed to watch the mine and as soon as the changes are observed the Android application will reflect the changes.

Keywords: FRCNN, Neural network, Image processing, Deep Learning, ResNet, TensorFlow, Python

1. INTRODUCTION

Nonmilitary mines, often known as aquatic mines, are used in combat. During a conflict, mines are used to destroy naval assets. It's also used in the defense industry, where mines operate as a border to protect the country's marine territory. These mines prevent hostile maritime assets from entering the unmarked territory. The enemy must search the entire region for mines. The opponent is forced to assault in an unmined place, where the defense is ready for a fight. Unlike the older mines, the ultramodern mines are detonated by pressing a button. The discovery of underwater mines is critical in ensuring that civilians are not endangered in any way. Mines aid in securing high-altitude defense bases and preventing the leakage of sensitive information. Battlegroups will be able to pinpoint the exact location of mines and avoid losses with the help of a reliable and cost-effective method. The neural network's operation is comparable to that of a mortal brain. It's used to show the relationship between data across a computer system. This artificial network is primarily based on Machine Literacy. If a dependable and cost-effective technology was utilized, battle groups would be able to find the exact location of mines and save lives. The neural network works in the same way that a human brain does. It's a diagram that depicts the connections between data in a computer system. Machine literacy is the foundation of the artificial network. Mask RCNN creates an offer about the region in the image where the object might be present and then constructs bounding boxes and masks at pixel position, as well as forecasts the object's class. For producing point vectors from raw pictures, Mask RCNN uses FPN as the backbone. For searching items in regions, use RPN. Anchor boxes are utilized to align the point vector with the position in the raw image, which can then be compared to ground verity while discovering and utilizing the idea of IoU value.

2. LITERATURE REVIEW

[1] The paper mentions the simplest way of implementing various deep learning techniques, hence the modifications need to be done to the techniques this could be the major challenge of the paper. In this paper modules and sub-modules used are **CNN, Autoencoders, Deep Belief Networks, and GAN.** This paper provides an overview of the simplest ways to implement target recognition and hence not very efficient.

[2] In this paper, the author Huu-Thu Nguyen, Eon-Ho Lee 1, and Sejin Lee specified **sonar sensor** needs and challenges to auto-detect submerged **human bodies** underwater. Sonar images need to be tested at different levels of polarization and intensities, the target background must be considered as there will be scatterings and noises in the sonar image. The same model needs to be retrained on sonar images of various polarization and intensity.

[3] Self-Supervised Learning of Pretext-Invariant Representations is to construct image representations that are semantically meaningful via PIRL (Pretext Invariant Representation Learning) that do not require semantic annotations for a large training set of images. To achieve the highest single crop top-1 accuracy of all

self-supervised learners that use a single **ResNet-50 model.**

[4] In this paper, the author has specified more on various techniques used for detecting sea mines. The major challenge of this paper was images need to be manually annotated and the overhead of labelling is very large when dealing with huge datasets. In this paper, they have used the **Mask RCNN model** which Region-Based Convolutional Neural Network.

[5] in this paper, the methodology involves a Masked RCNN module that comprises numerous convolutional layers. In this referral paper, the dataset is a set of images downloaded from the web hence a lot of pre-processing, labeling, and augmentation is required.

[6] In this referral paper, **Gabor Filter and K-means clustering** algorithm is used. Gabor Filter is used for feature extraction, and the K-means Clustering algorithm is used for segmentation. The accuracy and efficiency of K-Means clustering are not accurate.

[7] In this referral paper mainly two techniques are used, **Homomorphic, CLAHE, and Wavelet Filtering Techniques**

These techniques help to enhance the image quality and removing the unwanted noise enhances the image quality.

This survey paper also mentioned various other techniques for image enhancement such as a **median filter** for better quality and **RGB** for color level stretching.

[8] In this referral paper they have specified image denoising techniques which include **Spatial Domain Filter, Frequency Domain Filter, Mean Filter, Median Filter, and Adaptive Filter.** The paper does not consider any hybrid filters which are more efficient in de-noising images and for a given dataset, the right kind of filter cannot be decided beforehand, we'll have to implement each of the filters on the dataset.

Title of the paper	**Authors of the paper**	**Model/Sub Model used**
A Review on Deep Learning-Based Approaches for Automatic Sonar Target Recognition	Dhiraj Neupane and Jongwon Seok	CNN, Autoencoders, Deep Belief Networks, GAN
Study on the Classification Performance of Underwater Sonar Image Classification Based on Convolutional Neural Networks for Detecting a Submerged Human Body	Huu-Thu Nguyen, Eon-Ho Lee 1 and Sejin Lee	AlexNet, GoogleNet
Self-Supervised Learning of Pretext-Invariant Representations	Ishan Misra, Laurens van der Maaten	PIRL (Pretext Invariant Representation Learning)
Underwater Mine Detection using Image Processing	N Abhishek, Arjun, Bharathesh, Kavitha K S, Prof. Manonmani S, Dr. Shanta Rangaswamy	MaskRCNN model
Underwater Fish Detection	Aditya Agarwal,Manonmani S,Gaurav Rawal,Tushar Malani,Navjeet Anand.	Masked RCNN
Image Segmentation Using Gabor Filter and K-Means Clustering Method	Agyztia Premana, Akhmad Pandhu Wijaya, Moch Arief Soeleman.	Gabor Filter and K-means clustering algorithm.
Comparative analysis of combining various enhancement filtering techniques for underwater images	Manonmani S, Dr. Shanta Rangaswamy	Homomorphic, CLAHE and Wavelet Filtering Techniques
Survey On Image Denoising Techniques	Manonmani,Lalitha V.,Dr. Shanta Rangaswamy.	Spatial Domain Filter, Frequency Domain Filter, Mean Filter, Median Filter and Adaptive Filter

Table 1. Literature Review

3. BACKGROUND

3.1 DEEP NEURAL NETWORK

A deep neural network is an artificial neural network (ANN) with several layers between the input and output layers (DNN) as shown in Fig.1. Neurons, synapses, weights, biases, and functions are all basic components of neural networks, which come in a range of forms and sizes.

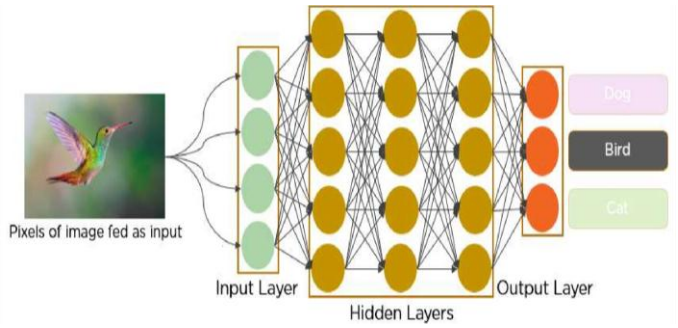

Fig.1 Deep Neural Network Architecture

3.2 CONVOLUTIONAL NEURAL NETWORK

The CNN is a sort of neural network as shown in Fig.2 that is quite similar to human vision and thought. Various computer vision applications have become an important part of this over time. CNN's were constructed for the first time in the 1980s. At the time, this neural network was the best at recognizing manual digits. The code reader has mostly been used or built to read zip codes, pin codes, and other codes of a similar kind.

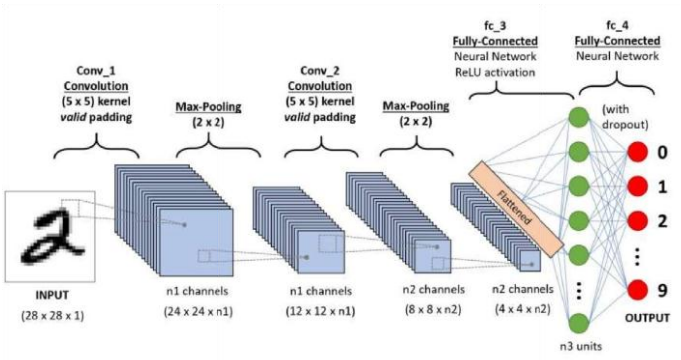

Fig.2 A traditional CNN Architecture

3.3 GENERATIVE ADVERSARIAL NETWORK

A generative adversarial network (GAN) is a machine learning (ML) model in which two neural networks compete to improve the accuracy of their predictions as shown in Fig.1. GANs are frequently unsupervised and learn by playing a cooperative zero-sum game

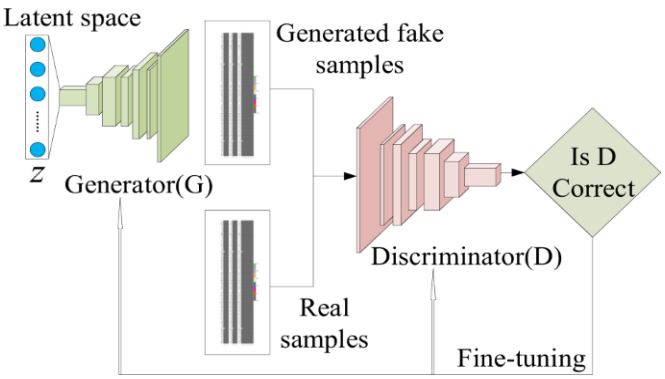

Fig.3 Generative Adversarial Network

4. CONCLUSION

The detection of the sea mines can be done in real-time or in real-time in order to be more effective in its usage to the naval forces of the country. A more extensive dataset that involves actual SONAR generated images and contains a wide selection of mines of all shapes, sizes, and specifications, images of different visibilities, etc can be used to train a more comprehensive detection model that detects accurately across all these variations. Models may be trained using different machine-learning techniques like YONO v3 and a few more recent approaches which can lead to improved performance and outcomes.

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