OIL SPILLS DETECTION ON SEA SURFACE USING SENTINEL-1 SAR IMAGES

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ABSTRACT

Identification of an oil spill is additionally essential to evaluate the potential spread and float from the source to the adjacent coastal terrains. In such a manner, usage of Synthetic Aperture RADAR (SAR) information for the recognition and checking of oil spills has gotten extensive consideration as of late, because of their wide zone inclusion, day-night, and all-weather capabilities. The present examination studies an oil spill that occurred in some regions by applying Sentinel 1 SAR- C images. Approaches dependent on MATLAB images examination have been produced for distinguishing oil spills from referred common leaks just as oil slick procedures. In this work, the Oil spill is located on the ocean/sea using the YOLO algorithm. An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially the marine ecosystem, due to human activity, and is a form of pollution. The term is usually given to marine oil spills, where oil is released into the ocean or coastal waters. Hence, oil spill detection should be considered an essential research issue. So, here oil spill will be located with the YOLO algorithm with MATLAB. The results will give better outputs when compared to existing works.

Keywords: MATLAB, GSM, Arduino, SAR-C, Sentinel 1, YOLO algorithm.

I. INTRODUCTION

Oil spill, leakage of petroleum onto the surface of a large body of water. Oceanic oil spills became a major environmental problem in the 1960s, chiefly as a result of intensified petroleum exploration and production on continental shelves and the use of supertankers capable of transporting more than 500,000 metric tons of oil. Spectacular oil spills from wrecked or damaged supertankers are now rare because of stringent shipping and environmental regulations. Nevertheless, thousands of minor and several major oil spills related to well discharges and tanker operations are reported each year, with the total quantity of oil released annually into the world's oceans exceeding one million metric tons. [1] The unintentional or negligent release of used gasoline solvents and crankcase lubricants by industries and individuals greatly aggravates the overall environmental problem. Combined with natural seepage from the ocean floor, these sources add oil to the world's waterways atthe rate of 3.5 million to 6 million metric tons a year.

Oil-spill damage:

The costs of oil spills are considerable in both economic and ecological terms. Oil on ocean surfaces is harmful to many forms of aquatic life because it prevents sufficient amounts of sunlight from penetrating the surface, and it also reduces the level of dissolved oxygen. Crude oil ruins the insulating and waterproofing properties of feathers and fur, and thus oil-coated birds and marine mammals may die from hypothermia.[2] Moreover, ingestedoil can be toxic to affected animals, and damage to their habitat and reproductive rate may slow the long-term recovery of animal populations from the short-term damage caused by the spill itself.

II. LITERATURE SURVEY

[1] Animal Pramanik, Sobhan Sarkar and J. Maiti: Oil spill at the workplace is one of the potential hazards in industry. Though it has not attracted more importance from the research point of view, it can lead to economicloss for the industry through the occurrence of accident phenomena like slipping, firing, or pollution to the environment. Hence, oil spill detection should be considered an essential research issue. To address this, the present study endeavors to use the image processing technique for oil spill detection using the image data retrieved from an integrated steel plant in India.

[2] Andrea Montali, Giorgio Giacinto, Maurizio Migliaccio, and Attilio Gambardella: Oil spill detection using SAR images is possible because of the damping effect of the short wind waves caused by the presence of oil on the sea surface. As a consequence, an oil spill is physically a dark patch in SAR images. The sea radar image is a representation of the backscatter return, and the intensity of the pixel is proportional to the surface roughness at the scale of radar wavelength (Bragg scattering). The radar backscatter coefficient is a function of the viewing geometry of the SAR. In this study, classical features extracted from Synthetic Aperture Radar (SAR)Images and used in oil spill classification procedures have been examined/evaluated and ranked in the function oftheir effectiveness. The best features have been used to perform the classification task using Support Vector Machine (SVM) using GLCM features.

[3] European Space Agency (ESA): The European Space Agency (ESA) is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. The data access types ranging from open access to a simple authentication (with a personal EO Sign In account) while a data access request or a project proposal are needed from the users for collections subject to access restrictions.

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Summary/Outcomes: Collected the dataset.

[5] Jorge E. Espinosa, Sergio A. Velastin: This paper presents a comparative study of two deep learning models used here for vehicle detection. Alex Net and Faster R-CNN are compared with the analysis of an urban video sequence. Several tests were carried to evaluate the quality of detections, failure rates and times employed to complete the detection task. The results allow to obtain important conclusions regarding the architectures and strategies used for implementing such network for the task of video detection, encouraging future research in this topic.

II. PROPOSED SYSTEM

In our proposal, we present a solution to detect oil spills in specific regions utilizing Sentinel 1 SAR-C images. Leveraging MATLAB's image analysis capabilities, we have developed approaches to distinguish between oil spills and natural phenomena. Once an oil spill is identified, our system automatically triggers notifications to designated members and simultaneously displays the information on an LCD screen for immediate awareness. [1] This integrated approach ensures timely response and mitigation efforts in areas affected by oil spills. By harnessing the power of Sentinel 1 SAR-C imagery and MATLAB's image processing algorithms, we aim to enhance the efficiency and accuracy of oil spill detection and response mechanisms, ultimately contributing to environmental conservation and disaster management initiatives.[3]

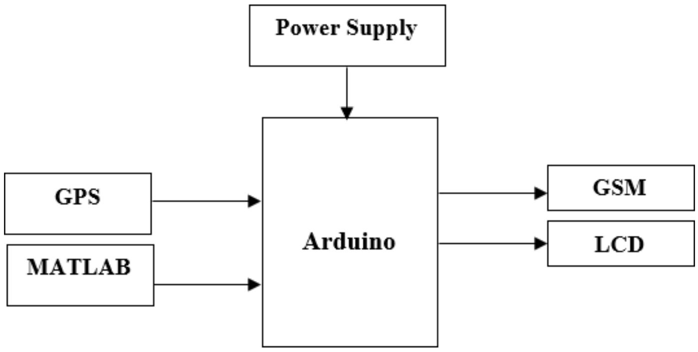

Fig:1 Block Diagram of Proposed Model

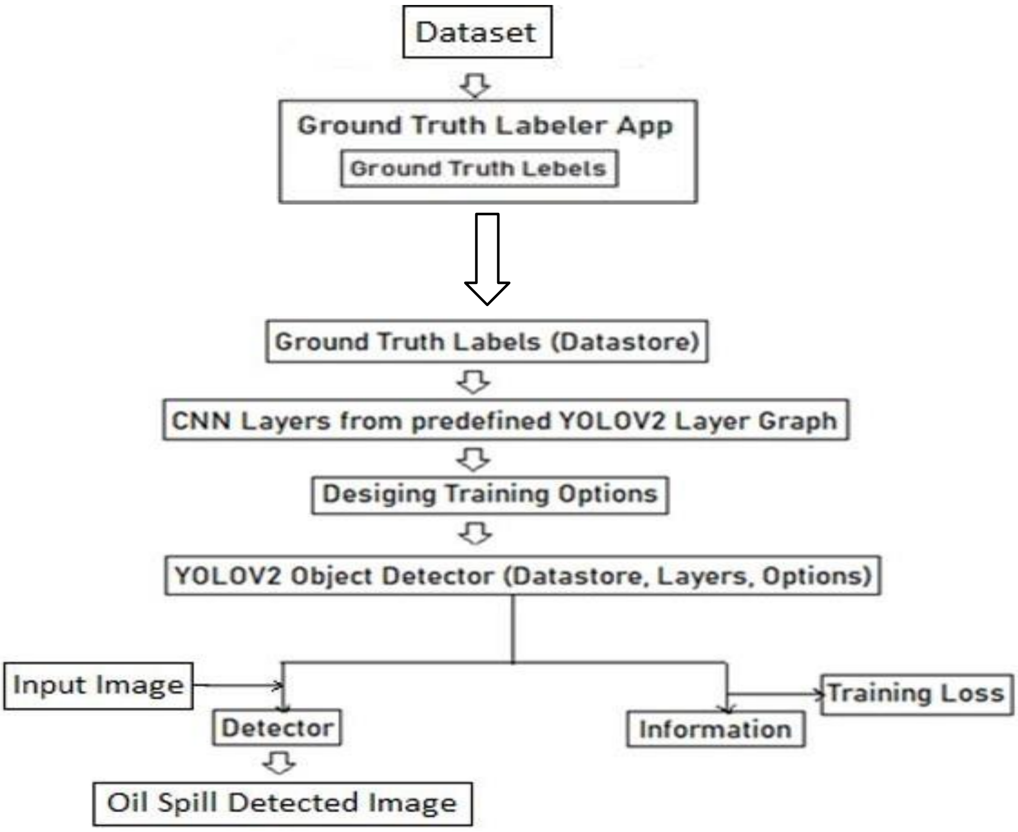

Fig:2-Flowchart

Table-1: Difference between Existing and Proposed Model

Parameter	Existing Model	Proposed Model
Algorithm/Methodology	Digital image processing with contrast increase, unwanted area segmentation. Not suitable for SAR images.	Using MATLAB and YOLOv2 Algorithm Fast, end-to-end,one-object per grid cell.Generalized with less false positives.
Communication	It can't display and send information when oil spills is detected to higher authorities.	It can send and display when oil spills is detected to higher authorities.

IV. IMPLEMENTATION

The project is implemented using Python and HTML. We have used python language for the implementation of the project because it is easy to learn and also it has rich set of libraries. Here we have used Tensor flow, Scikit, Numpy, Pandas and OpenCV and we have used Convolution Neural Network for the classification. Flask framework have been used for creating the connection python and HTML.

Convolutional Neural Network

The word 'Convolution" in the Convolution Neural Network describes a type linear operation using a mathematical function Here two functions will be multiplied to produce another function which displays how shape of a function is changed by another function. Here Images will be represented in the matrix form and it will be multiplied to give output they will be known as extracted features of a image.

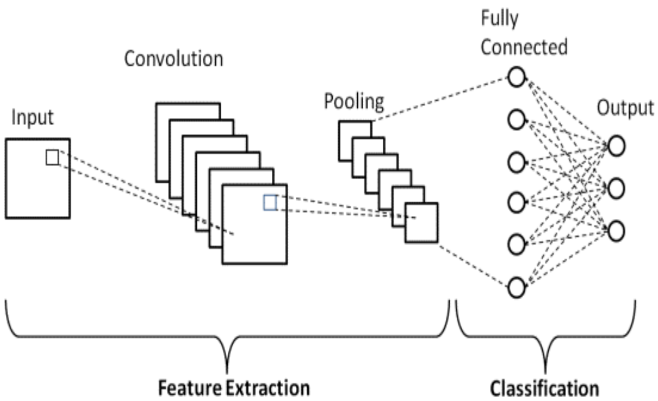

Fig 3 : CNN

ArchitectureThe above figure describes a simple CNN architecture.

1. Input Layer
2. Convolution Layer
3. Pooling Layer.
4. Fully Connected Layer.
5. Output Layer.

Datasets

Datasets of the SAR images is taken from the Kaggle website and those data were undergone for the training and testing and then the data is passed in the CNN model.

Data Pre-processing

Pre-processing is the step in analyzing any dataset, which includes removing unwanted images to clean the dataset for training purposes. And also added some of the missing data in the dataset. First, we stored 60 SAR images passed for training and testing.

Methodology

For Binary Images, The pixels of image value ranges between 0 to 255. (Zero means complete black, 255 means complete white. The greyscale ranges between 0 and 1.

For Colored Image, there will be three layers those are a red layer, a green layer, and a blue layer. Each colors have its unique value ranges between 0 -255.

First, we should import all the necessary libraries. Then stored datasets path will be set and here the images areresized with size=32, height=150 and width=150. The datasets are stored in three classes and we have just confirmed that the images belong to same class or not.

Once The datasets of SAR images is passed into training and testing those datasets were normalized into 0 or 1.

1	'input'	Image Input	128x128x3 images
2	'conv_1'	Convolution	16 3x3 convolutions with stride [1 1] and padding [1 1 1 1]
3	'BN1'	Batch Normalization	Batch normalization
4	'relu_1'	ReLU	ReLU
5	'maxpool1'	Max Pooling	2x2 max pooling with stride [2 2] and padding [0 0 0 0]
6	'conv_2'	Convolution	32 3x3 convolutions with stride [1 1] and padding [1 1 1 1]
7	'BN2'	Batch Normalization	Batch normalization
8	'relu_2'	ReLU	ReLU
9	'maxpool2'	Max Pooling	2x2 max pooling with stride [2 2] and padding [0 0 0 0]
10	'conv_3'	Convolution	64 3x3 convolutions with stride [1 1] and padding [1 1 1 1]
11	'BN3'	Batch Normalization	Batch normalization
12	'relu_3'	ReLU	ReLU
13	'maxpool3'	Max Pooling	2x2 max pooling with stride [2 2] and padding [0 0 0 0]
14	'conv_4'	Convolution	128 3x3 convolutions with stride [1 1] and padding [1 1 1 1]
15	'BN4'	Batch Normalization	Batch normalization
16	'relu_4'	ReLU	ReLU
17	'yolov2Conv1'	Convolution	128 3x3 convolutions with stride [1 1] and padding 'same'
18	'yolov2Batch1'	Batch Normalization	Batch normalization
19	'yolov2Relu1'	ReLU	ReLU
20	'yolov2Conv2'	Convolution	128 3x3 convolutions with stride [1 1] and padding 'same'
21	'yolov2Batch2'	Batch Normalization	Batch normalization
22	'yolov2Relu2'	ReLU	ReLU
23	'yolov2ClassConv'	Convolution	24 1x1 convolutions with stride [1 1] and padding [0 0 0 0]
24	'yolov2Transform'	YOLO v2 Transform Layer.	YOLO v2 Transform Layer with 4 anchors.
25	'yolov2OutputLayer'	YOLO v2 Output	YOLO v2 Output with 4 anchors.

Fig:4 Layers of our Model

Here, the detection of prostate cancer is performed using YOLO network. In YOLOv2 the details of each block in the visualization can be seen by hovering over the block. Each Convolution block has the Batch Norm normalization and then Leaky Relu activation except for the last Convolution block. YOLO divides the input image into an **S×S** grid. Each grid cell predicts only **one** object.

Application

Fast. Good for real-time processing, Predictions (object locations and classes) are made from one single network. Can be trained end-to-end to improve accuracy. YOLO is more generalized. It outperforms other methods when generalizing from natural images to other domains like artwork.

V. RESULTS

This project describes an algorithm and software application for oil slicks detection on the sea surface. Some experimental results demonstrate the application's ability to process SAR images and to detect oil slicks on the sea surface automatically.

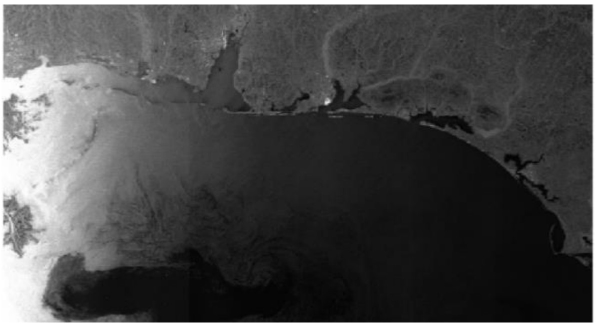

Fig:5-Input Image

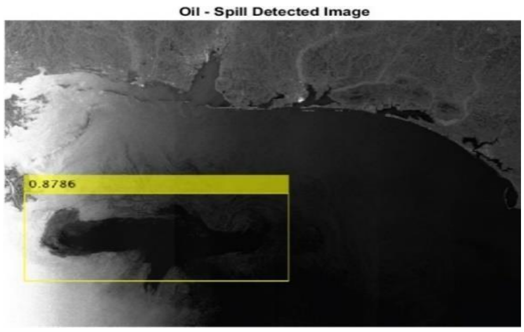

Fig:6-Output Image

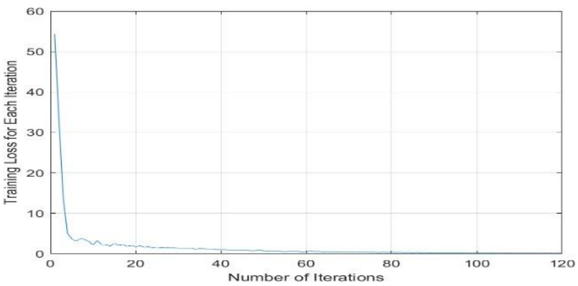

Fig:7-Training Losses

Fig:8-Result of Communication

VI. CONCLUSION AND FUTURE WORK

This project describes an algorithm and software application for oil slicks detection on the sea surface. Some experimental results demonstrate the application's ability to process SAR images and to detect oil slicks on the sea surface automatically. In this work, we have used the YOLO v2 object detector. YOLO v2 improves the ability of the system by adding detection at multiple scales to help detect smaller objects. Moreover, the loss function used for training is separated into mean squared error for bounding box regression. Results of this work will show that our work gives better outcomes compared to existing works. Future work in the detection of oil spills on the sea surface using Sentinel-1 Synthetic Aperture Radar (SAR) images will likely focus on several innovative and interdisciplinary approaches to enhance detection accuracy, efficiency, and response capabilities. A key area of development will involve the refinement of machine learning and artificial intelligence algorithms to improve the automatic identification and classification of oil spills.

VII. REFERENCES

[1] The Editors of Encyclopaedia Britannica, Adam Augustyn, Adam Zeidan, “Oil spill”, Britannica, May 3, 2021 https://www.britannica.com/science/oil-spill

[2] Anima Pramanik, “Oil Spill Detection Using Image Processing Technique: An Occupational Safety Perspective of a Steel Plant”, Springer Nature Singapore Pte Ltd. 2019

[3] Andrea Montali, “Supervised pattern classification techniques for oil spill classification in SAR images: preliminary results”, Proceedings of SEASAR 2006, 23-26 January 2006, Frascati, Italy.