Jyothi Engineering College
NAAC Accredited College with NBA Accredited Programmes*
Approved by AICTE & affiliated to APJ Abdul Kalam Technological University
A CENTRE OF EXCELLENCE IN SCIENCE & TECHNOLOGY BY THE CATHOLIC ARCHDIOCESE OF TRICHUR
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NBA accredited B.Tech Programmes in Computer Science & Engineering, Electronics & Communication Engineering, Electrical & Electronics Engineering and Mechanical Engineering valid for the academic years 2016-2022. NBA accredited B.Tech Programme in Civil Engineering valid for the academic years 2019-2022.

Ship Detection Using SAR Imagery

Group No. : 17

Department of CSE
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Group Members

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GIT : https://github.com/NithinPeter-GIT/Group-17_final_project

Vision of the Department

- Creating eminent and ethical leaders in the domain of Computational Sciences through quality professional education with a focus on holistic learning and excellence.

Mission of the Department

- To create technically competent and ethically conscious graduates in the field of Computer Science and Engineering by encouraging holistic learning and excellence.
- To prepare students for careers in Industry, Academia and the Government.
- To instill Entrepreneurial Orientation and research motivation among the students of the department.
- To emerge as a leader in education in the region by encouraging teaching, learning, industry and societal connect.

Course Outcomes

C410.1 The students will be able to analyse a current topic of professional interest and present it before an audience.

C410.2 Students will be able to identify an engineering problem, analyse it and propose a work plan to solve it.

C410.3 Students will have gained thorough knowledge in design, implementations and execution of Computer science related projects.

C410.4 Students will have attained the practical knowledge of what they learned in theory subjects.

C410.5 Students will become familiar with usage of modern tools.

C410.6 Students will have ability to plan and work in a team

CO Mapping to POs

	POs											
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C410.1	3	2	3	2	3	3	2	3	3	2	3	3
C410.2	2	3	3	3	3	3	2	3	2	3	3	3
C410.3	3	2	3	3	3	2	3	3	2	3	3	3
C410.4	3	3	3	2	3	3	3	2	3	3	3	3
C410.5	2	3	2	3	2	3	2	3	2	3	2	2
C410.6	3	3	3	2	2	3	2	3	2	3	2	2
Average	2.67	2.67	2.83	2.5	2.67	2.83	2.33	2.83	2.33	2.83	2.67	2.67

Contents

- Introduction
- Literature Survey
- Proposed System
- Software & Hardware Requirements
- Modules
- Data Flow Diagram
- UML Diagram
- Applications of Proposed System
- Conclusions
- References

Introduction

- In this project we present an innovative way to detect ships in the ocean using SAR image
- Detection of ships is complicated, especially under unfavourable conditions, such as during night-time or on cloudy days
- Locations of ships in the ocean can be useful in many situations like finding route,search & rescue, surveillance, fisheries management, etc.

Literature Survey

1. Improved YOLOv3

- It is extraordinarily important to increase the ship detection speed, because it can provide real-time ocean observation and timely ship rescue.
- In order to solve this problem, we use a high-speed SAR ship detection approach by improved YOLOv3
- We improved YOLOv3 by reducing the size of the network to reduce time consumption which can further increase the detection speed
- This approach achieves high-speed ship detection in SAR images, authentically, requiring only 24ms per image, whose speed is 2.3 times faster than the original YOLOv3

- The detection speed of our improved YOLOv3 is 2.3 times faster than the original YOLOv3
- This approach achieves high speed ship detection in SAR images, requiring only 24ms per image
- The improvements made maintained the accuracy and at the same time increased speed of detection

2. YOLOv3-Ship

The main contributions of this method can be listed as follows

- Determine the anchor settings for the ship dataset by kmeans++ algorithm
- Design a convolutional neural network named Darknetship to solve the problem of excessive YOLOv3 parameters.
- Embed the Squeeze-and-Excitation module in YOLOv3 to increase the network's ability to extract global features.

- YOLOv3-ship has higher map (mean average precision) values and same fps (frame per second) values compared to YOLOv3
- This proves that YOLOv3-ship improves the performance of the YOLOv3 by a large margin without speed drops
- A conclusion can be drawn that the YOLOv3-ship improves the detection accuracy of YOLOv3 for large and medium objects
- This may be attributed to the modelling effects of SE module on the channels of salient objects

3. Using CNN approach for ship detection in Sentinel-1 SAR imagery

- This paper proposes a technique to implement a system to detect and identify the location of ship using CNN in SAR images.
- In first stage, pre-processing of SAR image is carried out. In pre-processing back-geocoding, averaging, binary conversion and image morphology are performed.
- After image morphology reflectance values of the images are normalized to a standard reflectance value
- The input images are passed through a previously trained CNN model and end up in convolutional feature map
- Finally it uses the features computed by CNN to locate and obtain predefined number of regions (bounding boxes) that may have objects(ships)

Conclusion

- Images are cropped into a smaller size to apply to neural network process to detect ships
- Faster R-CNN Vgg16 took almost 24 hours to complete the process with 30 images
- Ships are categorized into small medium and big
- This method helps to maintain a real time surveillance of ships with its size and route

4. Significance of ship based detection from SAR imagery

- Synthetic Aperture Radar images have potential applications in the surveillance scenario which is a useful tool in monitoring and crime control as well as in marine traffic management
- Ships can be easily discerned in the SAR images due to their bright intensity which results due to the strong radar back -scatter from their metal surface
- But presence of speckle noise, sea ice and coastline structure, the ship detection process is affected since these non-ship features in the sea also exhibit high intensities in the SAR image.
- So this paper is proposed to differentiate ship and non ship targets

Conclusion

- The experimentation of the proposed work was carried out using seven SENTINEL 1A SAR images
- The algorithm used is simple and easy to implement.
- To reduce the complexity of target detection process, only the significant points which are the brightest points in the SAR image are identified and used for discrimination process, thus strengthening the efficacy of the proposed algorithm

5. Classification of Patterns

- First step in classifying patterns is image denoising
- Here Non Local Means filter method is used for denoising
- This proposed method uses the features of
  - Local Binary Patterns (LBP)
  - RGB color space
  - HSV color space
- Denoising is done due to the speckle noise found in SAR images which causes loss of the fine features required for pattern classification
- Pattern classification can be done with the help of feature extraction obtained from the region of interest

Denoising

- Done prior to feature extraction to remove unwanted speckle noise
- Denoising process is based on Maximum Likelihood estimation method

Feature Extraction

- On the denoised high resolution SAR images, Local Binary patterns (LBP) is used
- Homogeneous and heterogeneous areas of SAR images can be identified with LBP

Classification

- Classification is the final stage by which different patterns get segmented
- A fusion method is proposed for classifying these patterns identified involving RGB and HSV colour spaces and LBP

Conclusion

- Proposed algorithm is based on the fusion of three features for SAR image classification
- Three feature extraction method is applied on the input image
- Input image contains different patterns which are highlighted using different colours in the output
- Results from this proposed method reveal improvements in terms of accuracy in classifying different patterns in SAR images

Proposed System

- High speed ship detection using YOLO
- Fast detection means we can have real time detection is possible
- SAR images are used so that we can detect ships even in adverse weather conditions

Software And Hardware Requirements

Operating System : Windows

Programming Platform : VS Code / Jupyter Notebook / Google Colab

Programming Technologies : Python , TensorFlow

CPU : Intel core i5 or above (or its equivalent alternatives)

RAM : 4GB or above

Hard Disk : 500GB

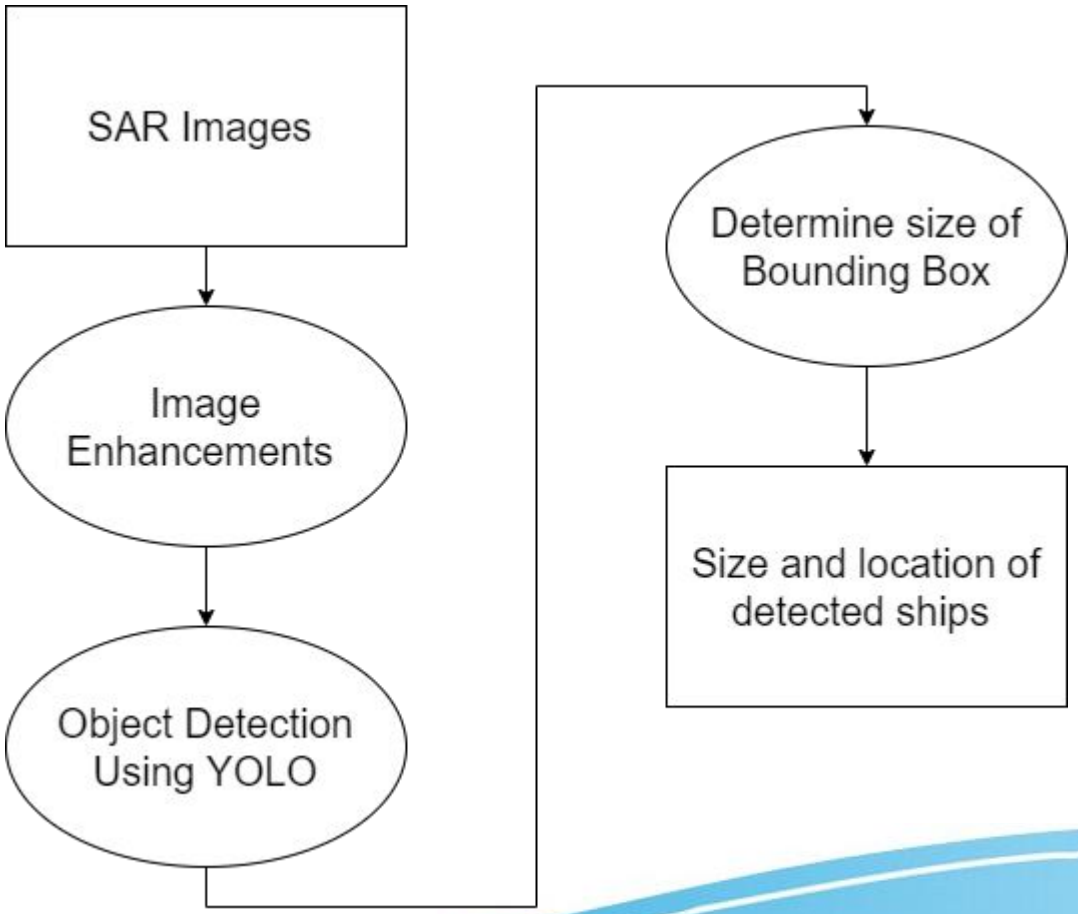
Modules

- **Data Acquisition Module**
  - SAR image dataset collection
  - Set the sample size
- **Image Enhancement Module**
  - Noise Reduction
  - Size Correction
- **Ship Detection Module**
  - Features are extracted
  - YOLO detection algorithm is used
  - Location of ships are identified

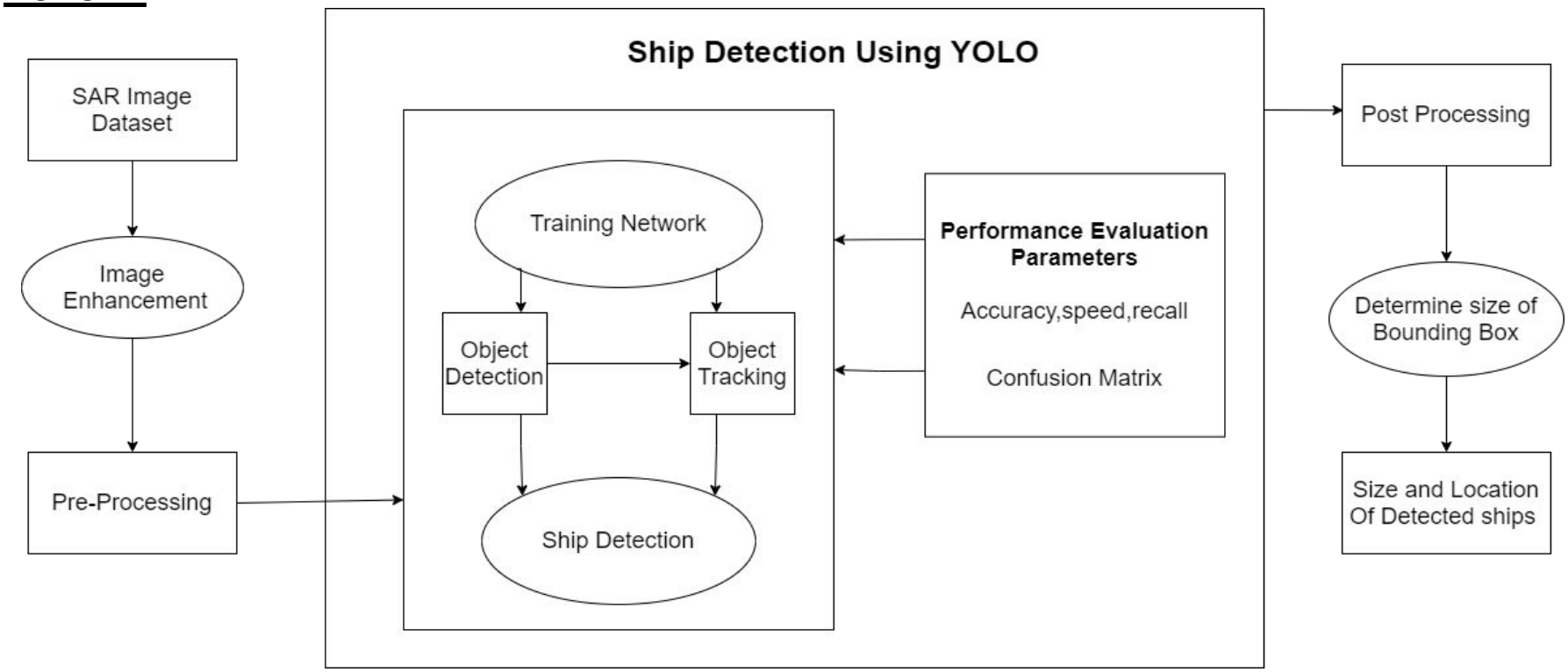
Data Flow Diagram

Level 0 :

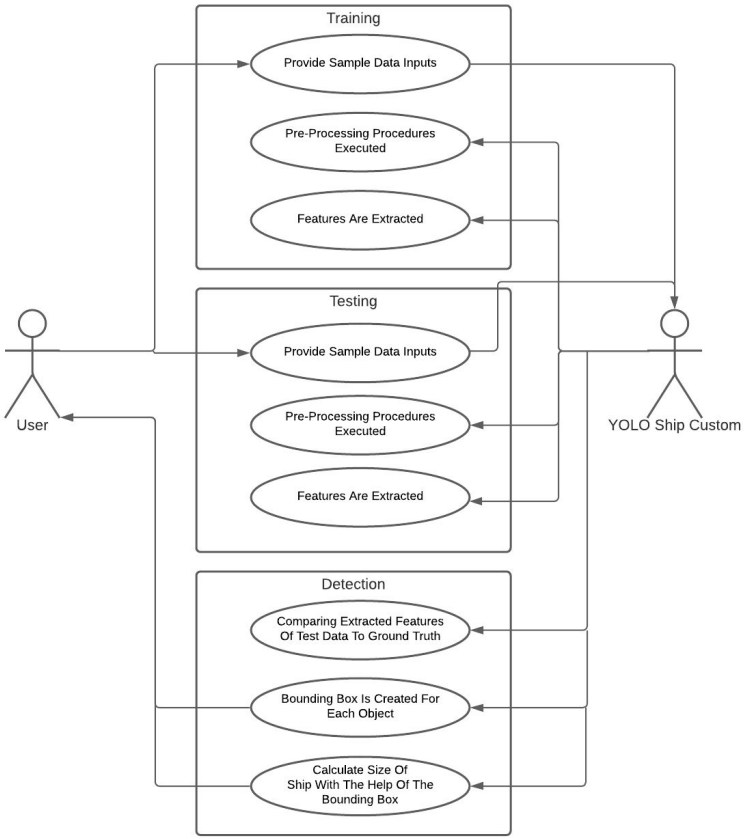
Level 1 :


SAR Images
Image Enhancements
Object Detection Using YOLO
Determine size of Bounding Box
Size and location of detected ships

Level 2 :


Ship Detection Using YOLO
SAR Image Dataset
Image Enhancement
Pre-Processing
Training Network
Object Detection
Object Tracking
Ship Detection
Performance Evaluation Parameters
Accuracy,speed,recall
Confusion Matrix
Post Processing
Determine size of Bounding Box
Size and Location Of Detected ships

UML Diagram


Training
Provide Sample Data Inputs
Pre-Processing Procedures Executed
Features Are Extracted
Testing
Provide Sample Data Inputs
Pre-Processing Procedures Executed
Features Are Extracted
Detection
Comparing Extracted Features Of Test Data To Ground Truth
Bounding Box Is Created For Each Object
Calculate Size Of Ship With The Help Of The Bounding Box
User
YOLO Ship Custom

Advantages

- Fast and accurate ship Detection
- It can be used in different weather conditions
- Real time monitoring is possible

Disadvantages

- Limited number of SAR sensors
- Longer revisit cycle for repeated images
- Relatively lower resolution

Applications of proposed system

- It can be used for ocean surveillance
- It can be used to track incoming and outgoing ship in harbour
- It can be used to monitor for cross border violations
- It can be used rescuing ships during disasters

Conclusion

- This YOLO based ship detection system can be used in different purposes like disaster management, military use, port authorities, surveillance, etc.
- This system can be used in different weather conditions like during fog, rain, storm, cyclone, etc.
- The system is both fast and accurate so it can also be used for real time monitoring.

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Thank You