iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36782

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Iceberg Detection using Satellite Images

Dr. Ashoka K[1], Gousiya Banu I[2], Harshita J R[3], Nandini B[4], Tejaswini[5], Rakshitha T M[6]
[1, 2, 3, 4, 5, 6]*Department of Computer Science and Engineering, BIET Davanagere*

Abstract: ***Chunks of ice present genuine risks for transport route and seaward establishments. Subsequently, there is a huge interest to limit them ideal and over tremendous regions. As a result of their autonomy of overcast cover and sunlight, satellite Synthetic Aperture Radar (SAR) pictures are among the favoured information hotspots for functional ice conditions and ice sheet events. The picture spatial goal for the most part utilized for chunk of ice observing changes between a couple and 100 m. Prepared SAR information are portrayed by dot clamour, which causes a grainy appearance of the pictures making the distinguishing proof of ice shelves amazingly troublesome. The techniques for satellite checking of hazardous ice developments, similar to ice shelves in the Arctic oceans address a danger to the security of route and monetary action on the Arctic rack. Along these lines, here we have thought of a thought of an application which distinguishes the Iceberg pictures utilizing satellite pictures and it is proposed by utilizing Convolutional Neural Networks (CNN) grouping.***
Keywords: Synthetic Aperture Radar (SAR), Iceberg and Convolutional Neural Network (CNN)

I. INTRODUCTION

An icy mass is an exceptionally enormous item that can be recognized in the vast ocean both outwardly and by radar. On a basic level an ice shelf can likewise be distinguished by sonar. In the vast ocean, an icy mass produces screeching, popping, and squeaking sounds brought about by mechanical anxieties and breaking, and these sounds can be recognized submerged up to 2 km (in excess of a pretty far). In summer, bergs can likewise create a piercing murmuring sound called "bergy seltzer," which is because of the arrival of high-pressure air rises from the ice as it softens in the hotter water.

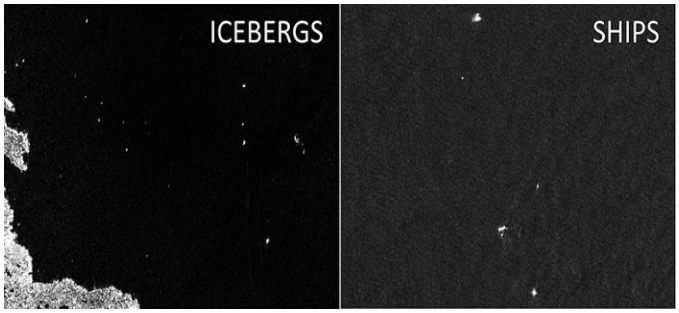

Fig. 1 Satellite images of Icebergs and Ships

However route in chunk of ice swarmed waters has been perceived from early occasions to be full of with extraordinary risks, it is just relatively as of late that endeavours have been made to apply logical strategies to the location of these drifting threats to route. Early whalers and wayfarers in Arctic and Antarctic waters met and conquered these risks without such help, however the current conditions of ocean travel in waters infrequently subject to intrusion by chunks of ice are so unique as to deliver extraordinary safeguards important. A portion of these conditions are the speeding up traveller vessels, the substitution of wooden frames by steel, and the need, despite contest from rival steamship organizations, to finish the journeys inside planned occasions. The little ice 'growler,' gliding practically lowered, isn't simply the most hard to recognize, but at the same time is nearly as hazardous an obstacle to present day steel ships as the ice shelf of enormous measurements, which is probably going to be all the more promptly saw even confused.

The issue of shielding dispatching from ice shelves is generally basic in two areas, the high-scope Southern Ocean and the north-western part of the North Atlantic. The Southern Ocean danger is expanding in light of the fact that huge holder dispatches—those incapable or reluctant to utilize the Panama Canal—can arrive at high southern scopes on travel from Australia or New Zealand to Cape Horn. No extraordinary measures are presently set up to secure such vessels. In the North Atlantic, the International Ice Patrol was set up in 1914 after the deficiency of the RMS Titanic to an icy mass in April 1912. Its undertaking is to follow icy masses as they enter transporting paths by means of the Labrador Current and to keep a consistent PC plot of the known or assessed

whereabouts of each berg. Reports are communicated double a day to ships. Previously, icy mass positions were cited by boats or airplane; nonetheless, it is turning out to be more normal that icy masses are cited by the understanding of satellite symbolism.

II. LITERATURE SURVEY

Armando Marino et.al., [1] presented a methodology named as a new calculation for chunk of ice location with double polarimetric SAR information. Concerning ice rack area with SAR pictures, a wide work was finished for the acknowledgment of colossal ice racks, yet the distinctive verification of little bergs or target embedded in sea ice is till irksome. At this moment, new finder is proposing to deal with this issue reliant upon twofold polarimetry indiscernible pictures. The computation depends on the standard that little ice racks are contained in an obliged domain and they ought to have a volume responsibility that is higher appeared differently in relation to the sea or sea ice establishment.

Wolfgang Dierking et.al., [2] uses C-Band radar polarimetry. At this moment, revolved around assessments of polar metric C-band radar signs of pieces of ice in sea ice-got ocean areas. The essential objective is to assess the expected improvement of ice rack area while using radar polarimetry. The transcendent backscattering parts of ice sheets are inferred by evaluating different polarimetry boundaries. Degrees of the cross-polarization extents, the association coefficients among HH-and VV-entranced signs, and the entropy/alpha boundaries show a strong responsibility of volume scattering a large part of the time.

Howell et.al., [3] uses the RADARSAT-2 satellite is a impelled C-band designed hole radar (SAR) with an grouping of new modes including choices for polarization mixes, objectives, and area width. At this moment, examinations the ability of multi polarization data for recognizing and isolating boat what's more, cold mass targets Data used at the present time of particularly supported airborne Convair-580 SAR what's more, space borne ASAR HH/HV and HH/VV. By and large, the educational assortment used for evaluating disclosure and isolation includes 901 supported lumps of ice and boat targets.

Igor Zakharov et.al., [4] Recent examination has avowed that satellite altimetry can be used for recognizing lumps of ice. With a ultimate objective to support the altimetry-based approach, this assessment used 105 instances of frosty masses contained in both satellite altimeter data and ENVISAT-ASAR scenes for the Weddell Ocean domain. The issue of isolating boats and ice sheets subject to altimeter assessments was tended to using an outfit of robotized classifiers. An amount of ten features were portrayed from the altimetry sign to be used as pointer factors in oversaw gathering.

Jerry English et.al., [5] uses Space-based Automatic Recognizable proof System (S-AIS) data identified with satellite Manufactured Aperture Radar (SAR) imagery for Ship and Ice shelf Monitoring. The objectives of this work are to abuse S-AIS data for social occasion ground truth to improve existing boat/ice sheet isolation estimations and to show the utility of S-AIS data for functional lump of ice perception.

Armando Marino et.al., [6] proposed an estimation, the estimation proposed relies upon a trouble examination in the target space actually made and circulated by the makers, which was revolved around land-based goal disclosure. The computation can be seen as a negative channel focused on sea. Subsequently, every one of the features which have a Polari metric direct special corresponding to the sea are perceived. To show and support the technique two

Radar Sat. Armando Marino et.al., [7] proposed a technique. At the present time, strategy subject to the Polari metric disturbance examination is presented. The estimation can be seen as a negative channel focused on sea. Along these lines, all the features which have a Polari metric direct remarkable in connection to the sea are recognized and considered as targets. This moment, step channel is revolved around pieces of ice revelation

Vahid Akbari et.al., [8] proposed another strategy for customized unmistakable evidence of ice racks in significant standards Polari metric SAR pictures got during different seasons. This incorporates changing the computation to the sea ice conditions, and defying challenges concerning high piece of ice thickness, meteorological and oceanographic wonders in the fringe ice zone causing heterogeneity out of sight wreck.

Dr. Ch. Rupa et.al., [9] uses change strategies based framework has set ready for perceiving the lumps of ice in the standard information base pictures. This can prepared to recognize not simply the greater ice racks, can in like manner perceive humbler and medium pieces of ice. This framework has given 96% useful results during the time spent acknowledgment of the lumps of ice. The essential nature of this work is composing concentrate on related works with the assessment export on the results.

III.SYSTEM DESIGN

System design thought as the application of theory of the systems for the development of the project. System design defines the architecture, data flow, use case, class, sequence and activity diagrams of the project development.

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A. System Architecture

Convolution Neural Network are a class of Deep Neural Networks that can recognize and classify particular features from images and are widely used for analysing visual images. The term 'Convolution" in CNN denotes the mathematical function of convolution which is a special kind of linear operation wherein two functions are multiplied to produce a third function which expresses how the shape of one function is modified by the other. In simple terms, two images which can be represented as matrices are multiplied to give an output that is used to extract features from the image. The below figure 2 shows the complete architecture of the proposed work.

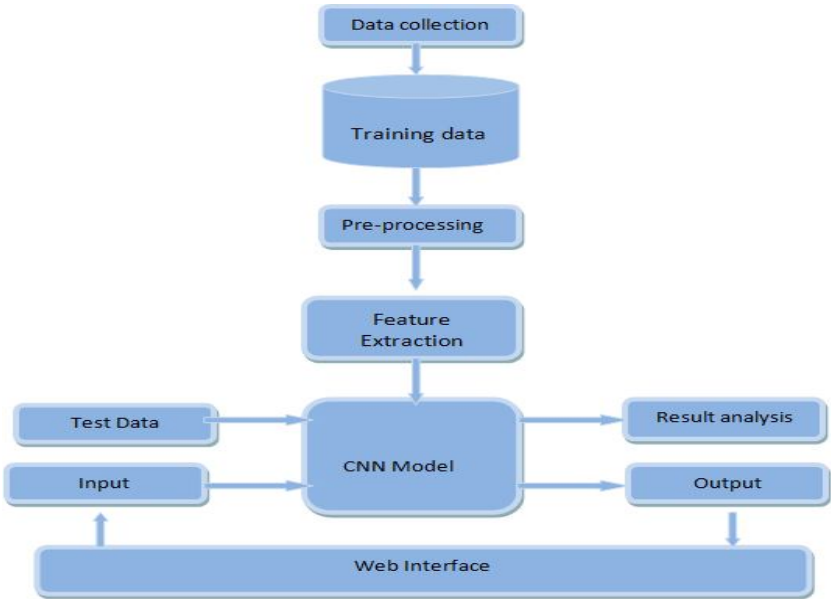

Fig. 2 Architecture Diagram

1) *Data Collection:* The process of gathering data depends on the type of project, for a DL project, images are used. The data set can be collected from various sources such as a file, database, sensor and other sources and some free data sets from internet can be used. Kaggle and UCI Deep learning Repository are the repositories that are used the most for data collection for Deep learning models. Kaggle is one of the most visited websites that is used for collecting data sets.
2) *Pre-processing:* Pre-processing refers to all the transformations on the raw data before it is fed to the machine learning or deep learning algorithm. For instance, training a convolutional neural network on raw images will probably lead to bad classification performances. The pre-processing is also important to speed up training (for instance, centring and scaling techniques.
3) *Feature Extraction:* When the input data to an algorithm is too large to be processed and it is suspected to be redundant then it can be transformed into a reduced set of features. Determining a subset of the initial features is called feature selection. The selected features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data. Feature extraction involves reducing the number of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power, also it may cause a classification algorithm to overfit to training samples and generalize poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Many machine learning practitioners believe that properly optimized feature extraction is the key to effective model construction.
4) *CNN* is a modified variety of deep neural net which depends upon the correlation of neighbouring pixels. It uses randomly defined patches for input at the start, and modifies them in the training process. Once training is done, the network uses these modified patches to predict and validate the result in the testing and validation process. Convolutional neural networks have achieved success in the image classification problem, as the defined nature of CNN matches the data point distribution in the image. As a result, many image processing tasks adapt CNN for automatic feature extraction. The architecture of CNN model is shown in figure 2.

There are two main parts to CNN architecture. A convolution tool that separates and identifies the various features of the image for analysis in a process called as Feature Extraction. A fully connected layer that utilizes the output from the convolution process and predicts the class of the image based on the features extracted in previous stages.

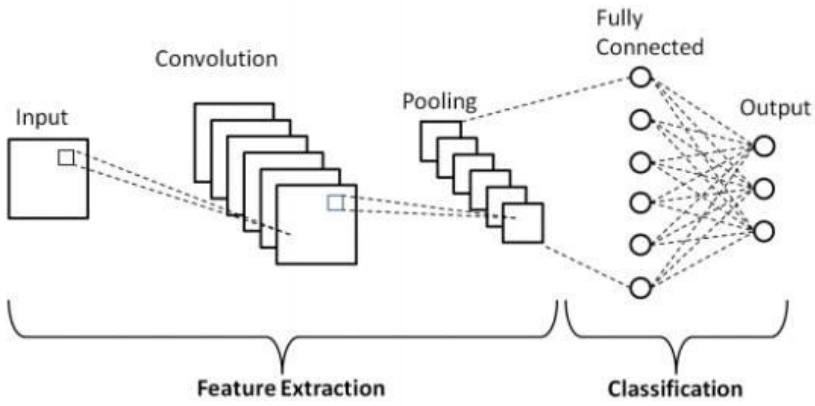

Fig. 3 Convolution neural network architecture

5) *Convolution Layer:* This layer is the first layer that is used to extract the various features from the input images. In this layer, the mathematical operation of convolution is performed between the input image and a filter of a particular size MxM. The output is termed as the Feature map which gives us information about the image such as the corners and edges. Later, this feature map is fed to other layers to learn several other features of the input image.
6) *Pooling Layer:* In most cases, a Convolutional Layer is followed by a Pooling Layer. The primary aim of this layer is to decrease the size of the convolved feature map to reduce the computational costs. This is performed by decreasing the connections between layers and independently operates on each feature map. Depending upon method used, there are several types of Pooling operations. In Max Pooling, the largest element is taken from feature map. Average Pooling calculates the average of the elements in a predefined sized Image section. The total sum of the elements in the predefined section is computed in Sum Pooling. The Pooling Layer usually serves as a bridge between the Convolutional Layer and the FC Layer.
a) *Fully Connected Layer:* The Fully Connected (FC) layer consists of the weights and biases along with the neurons and is used to connect the neurons between two different layers. These layers are usually placed before the output layer and form the last few layers of a CNN Architecture.
7) *Train and Test Data:* For training a model we initially split the model into 2 sections which are 'Training data' and 'Testing data'. The classifier is trained using 'training data set', and then tests the performance of classifier on unseen 'test data set'.
a) *Training Set:* The training set is the material through which the computer learns how to process information. Machine learning uses algorithms to perform the training part. Training data set is used for learning and to fit the parameters of the classifier.
b) *Test Set:* A set of unseen data used only to assess the performance of a fully-specified classifier.
8) *Evaluation:* Model Evaluation is an integral part of the model development process. It helps to find the best model that represents the data and how well the chosen model will work in the future. To improve the model hyper-parameters of the model can be tuned and the accuracy can be improved. Confusion matrix can be used to improve by increasing the number of true positives and true negatives. The output is predicted by analysing the test data as input along with test data output and then the output is displayed.
9) *Interface:* A web interface is built to take input and display an output. Flask language is used to build a web interface and pickle library is used to integrate both model and web page. Flask is an API of Python that allows building up web-applications. It was developed by Armin Rancher. Flask's framework is easy to learn because it has less base code to implement a simple web-Application. A Web-Application Framework or Web Framework is the collection of modules and libraries that helps the developer to write applications without writing the low-level codes such as protocols, thread management, etc. This web application can be some web pages, a blog, a wiki or go as big as a web-based calendar application or a commercial website. Flask is based on WSGI (Web Server Gateway Interface) toolkit and Jinja2 template engine. Flask is part of the categories of the micro-framework. Micro-framework is normally framework with little to no dependencies to external libraries. This has pros and cons. Pros would be that the framework is light, there are little dependency to update and watch for security bugs, cons is that some time you will have to do more work by yourself or increase yourself the list of dependencies by adding plugins.

IV. RESULTS

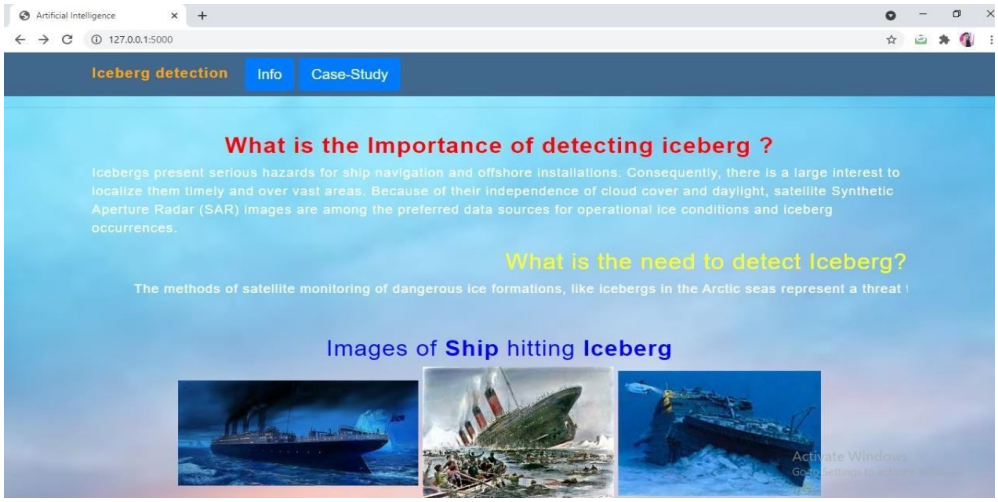

Fig. 4 Home Page

This page will give you information about the importance of detecting iceberg and some information about ships hitting iceberg.

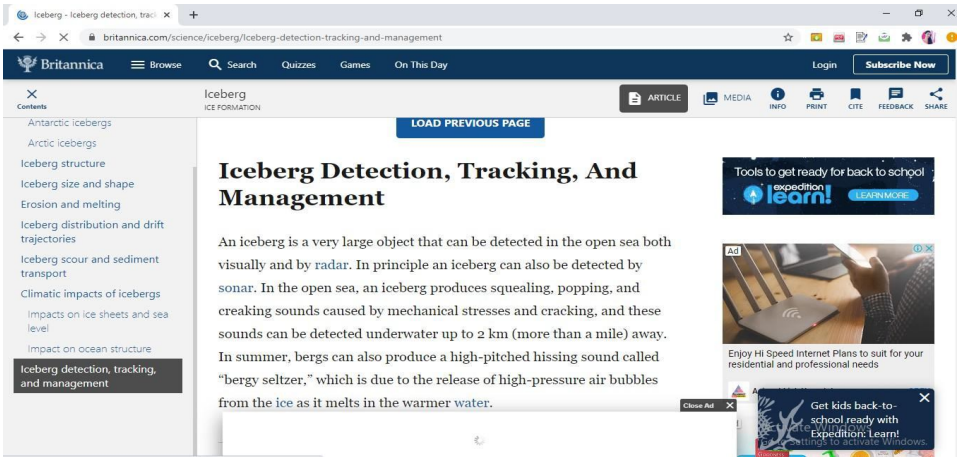

Fig. 5 Informative Page

When click on info in home page it will redirect to https://www.britannica.com/science/iceberg/Iceberg-detection-tracking-and-management this website. This page will give you information about iceberg.

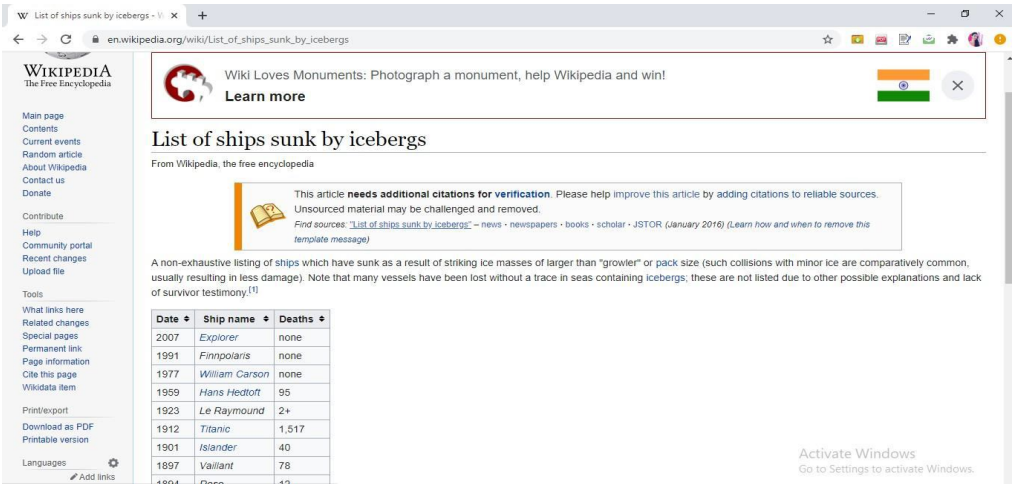

Fig. 6 Case Study Page

When we clicked on case study in home page it will redirect to https://en.wikipedia.org/wiki/List_of_ships_sunk_by_iceberg this website. This page will give you information about case studies on iceberg.

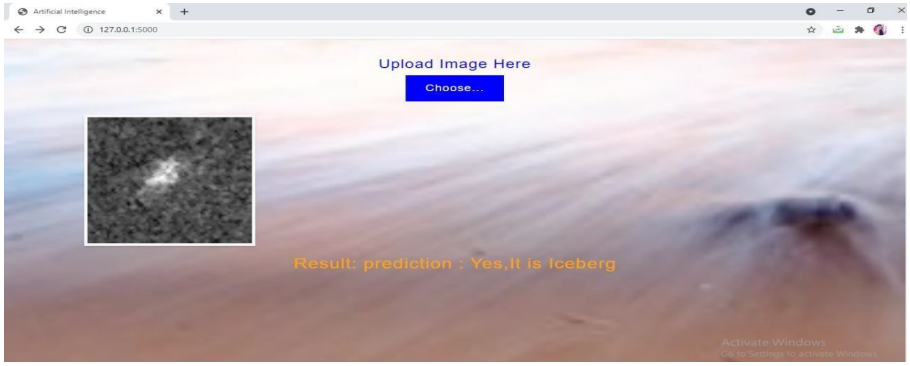

Fig. 7 Output Page

This page will give you information about the result. if predicted result is iceberg it display“ Yes, It is Iceberg”.

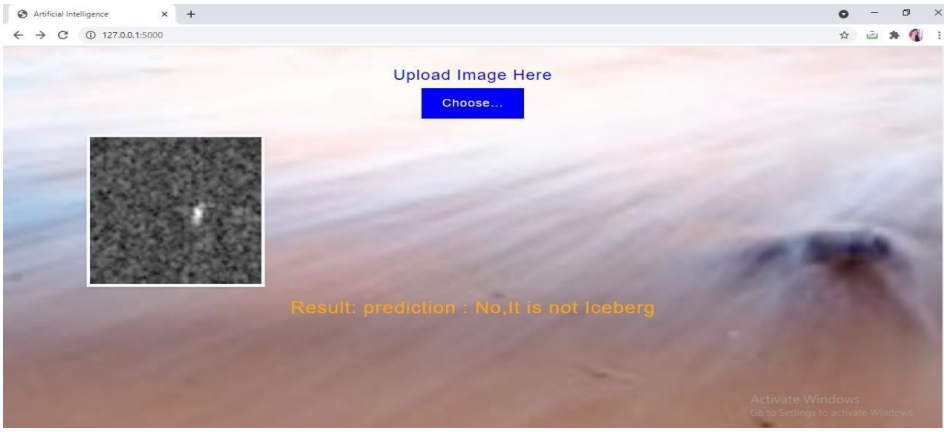

Fig. 8 Output Page

This page will give you information about the result. If predicted result is not a iceberg it display “ No, It is not Iceberg”.

V.CONCLUSION

In this work we used deep learning which can be used to solve a challenging real- world problem. We are able to detect and segment icebergs in an image, it would be of great help to the logistics and transportation team in northern countries like Sweden, Norway and Canada. It could bring a whole new dimension of transport for container ships and vessels by tracking icebergs from satellite images and videos in real-time. This implies that CNN can extract better features when presented with SAR images with different number of looks for the same target. The CNN is treated as a black box model, and additional experiments are necessary to understand how the change in image resolution affects the CNN internal activations. The use of additional procedures in the pre-processing step can potentially improve the classification results, and will be the focus of future work.

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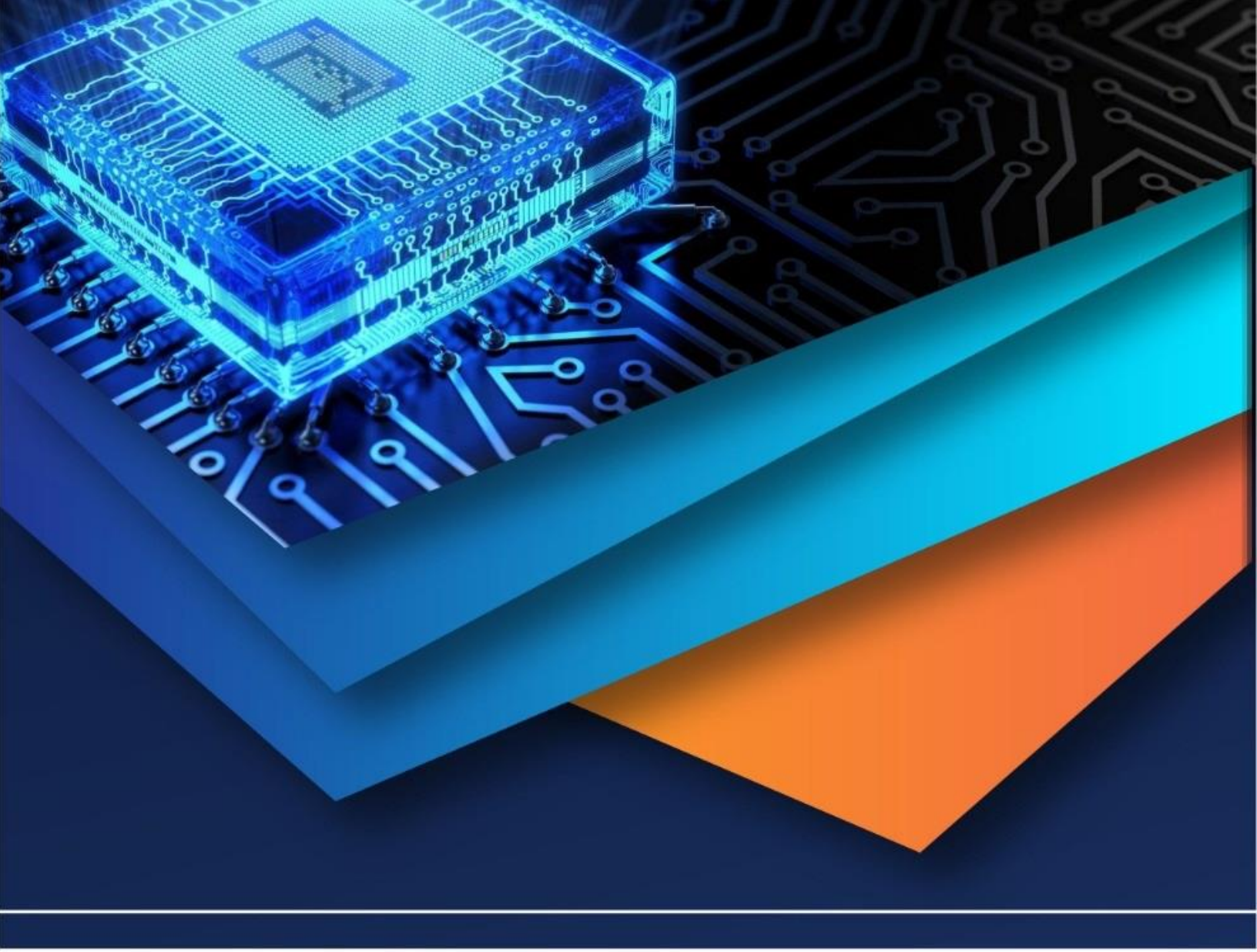

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