Vellore Institute of Technology

(Industrial Internship)

Iceberg Detection In Satellite Images Using IBM Watson Studio

using

ARTIFICIAL INTELLIGENCE

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Under the Guidance

of

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Submitted to the SmartInternz Externship Programme in fulfilment of the requirements for the Project (Iceberg Detection In Satellite Images Using IBM Watson Studio).

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CONTENT

1. INTRODUCTION

1.1 OVERVIEW:

Iceberg detection is found to be more critical in the previous researchers. High quality satellite monitoring of dangerous ice formations is critical to navigation safety and economic activity in the regions. The satellite images play a crucial role in the identification of the icebergs.

It is based on the satellite dataset for target classification and target identification. The iceberg detection is based on the statistical criteria for finding the satellite images. This model is used to identify automatically whether it is remote sensed target is iceberg or not. Sometimes the iceberg is wrongly classified as ship. This model is done to make accurate about the changes in the detection.

1.2 PURPOSE:

The main objective of detecting icebergs using satellite radar data and high spatial resolution images in the visible spectral range. The methods of satellite monitoring of dangerous ice formations, like icebergs in the Arctic seas represent a threat to the safety of navigation and economic activity on the Arctic shelf.

The developed method of iceberg detection is based on statistical criteria for finding gradient zones in the analysis of two-dimensional fields of satellite images. The approaches proposed to detect icebergs from satellite data allow improving the quality and efficiency of service for a wide number of users with ensuring the efficiency and safety of Arctic navigation and activities on the Arctic shelf.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

1. ***NAME:*** Iceberg Detection in Aerial Images Using Deep Learning Models

   AUTHOR: Ramkumar R, Suganthi J

   YEAR OF PUBLICATION: *2022*

   DESCRIPTION*:* The goal is to create iceberg recognition algorithms using high-resolution visible-wavelength remote sensing images and satellite radar images. The use of satellite technology to track potentially dangerous ice forms like ice sheets puts the economic growth and secure navigation of the Arctic shelf at risk. The statistical criteria for locating gradient regions in the assessment of two-dimensional areas of satellite data form the basis of the technique that was created for the identification of icebergs. The iceberg will be located in the higher-resolution satellite images using CNN's technique. A dataset of high-resolution SAR pictures from the satellites Landsat 8 and Sentinel 1 is subjected to the CNN algorithm.

   EXISTING PROBLEM*:*

   - Handling image artifacts and occlusions: Aerial images of icebergs can often contain artifacts, such as cloud cover, water reflections, and noise, which may interfere with accurate detection. Dealing with these artifacts and developing robust models that can handle occlusions and partial iceberg visibility is an ongoing research challenge.
   - Generalization to new data and environments: Models trained on one dataset or geographic region may struggle to generalize to different environments. Adapting the trained models to new datasets or areas with different iceberg characteristics and backgrounds is crucial for real-world applicability.
   - Interpretability and explainability: Deep learning models are often considered black boxes, making it difficult to understand their decision-making process. Developing techniques to interpret and explain the model's predictions can be important for gaining trust and acceptance of the proposed methods in practical applications.

2. ***NAME:*** A Computational Framework for Iceberg and Ship Discrimination: Case Study on Kaggle Competition

AUTHOR: XULEI YANG, JIE DING

YEAR OF PUBLICATION: 2020

DESCRIPTION*:* The ability to identify icebergs and ships in satellite synthetic aperture radar (SAR) data is crucial for developing an effective iceberg surveillance programme. A computational framework for iceberg and ship discrimination is presented in this article and is based on a collection of different deep learning and machine learning techniques. In this study, the most recent deep neural networks, DenseNet and ResNet, are used for end-to-end feature exaction and picture classification on the base of original SAR data. The suggested framework was just implemented as the main kernel for Kaggle's "Statoil/C-CORE Iceberg Classifier Challenge."

EXISTING PROBLEM*:*

- Real-time processing and scalability: In practical applications, real-time processing and scalability are important considerations. Developing computational frameworks that can efficiently process large volumes of satellite images and provide timely and accurate discrimination results is a significant challenge.
- Feature extraction and representation: Identifying discriminative features from satellite images that effectively differentiate between icebergs and ships is essential. Researchers often face the challenge of extracting meaningful features that capture relevant characteristics, such as texture, shape, and contextual information, from the image data.
- Limited and imbalanced dataset: Obtaining a diverse and representative dataset with a sufficient number of labeled images can be a challenge in tasks like iceberg and ship discrimination. Additionally, the dataset may suffer from class imbalance, where the number of iceberg and ship images is significantly different. Addressing these issues is crucial to ensure model generalization and performance.

3. ***NAME:*** Deep Learning for Iceberg Detection in Satellite Images

AUTHOR: SHUZHI DONG

YEAR OF PUBLICATION: 2020

DESCRIPTION*:* The ability to identify icebergs and ships in satellite synthetic aperture radar (SAR) data is crucial for developing an effective iceberg surveillance programme. A computational framework for iceberg and ship discrimination is presented in this article and is based on a collection of different deep learning and machine learning techniques. In this study, the most recent deep neural networks, DenseNet and ResNet, are used for end-to-end feature exaction and picture classification on the base of original SAR data. The suggested framework was just implemented as the main kernel for Kaggle's "Statoil/C-CORE Iceberg Classifier Challenge."

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- Limited and imbalanced dataset: Obtaining a diverse and representative dataset with a sufficient number of labeled images can be a challenge in tasks like iceberg and ship discrimination. Additionally, the dataset may suffer from class imbalance, where the number of iceberg and ship images is significantly different. Addressing these issues is crucial to ensure model generalization and performance.

EXISTING APPROACHES:

FEATURE EXTRACTION: One approach to iceberg detection is to extract features from satellite images that can be used to distinguish icebergs from other objects in the environment. These features can include the shape, size, and texture of the iceberg, as well as the brightness and contrast of the image.

MACHINE LEARNING: Machine learning techniques can be used to classify images as containing an iceberg or not. This can be done using a variety of machine learning algorithms, such as support vector machines, random forests, and deep learning.

DATA FUSION: Data fusion techniques can be used to combine information from different sources, such as satellite images, radar data, and weather data. This can help to improve the accuracy of iceberg detection.

2.2 PROPOSED SOLUTION

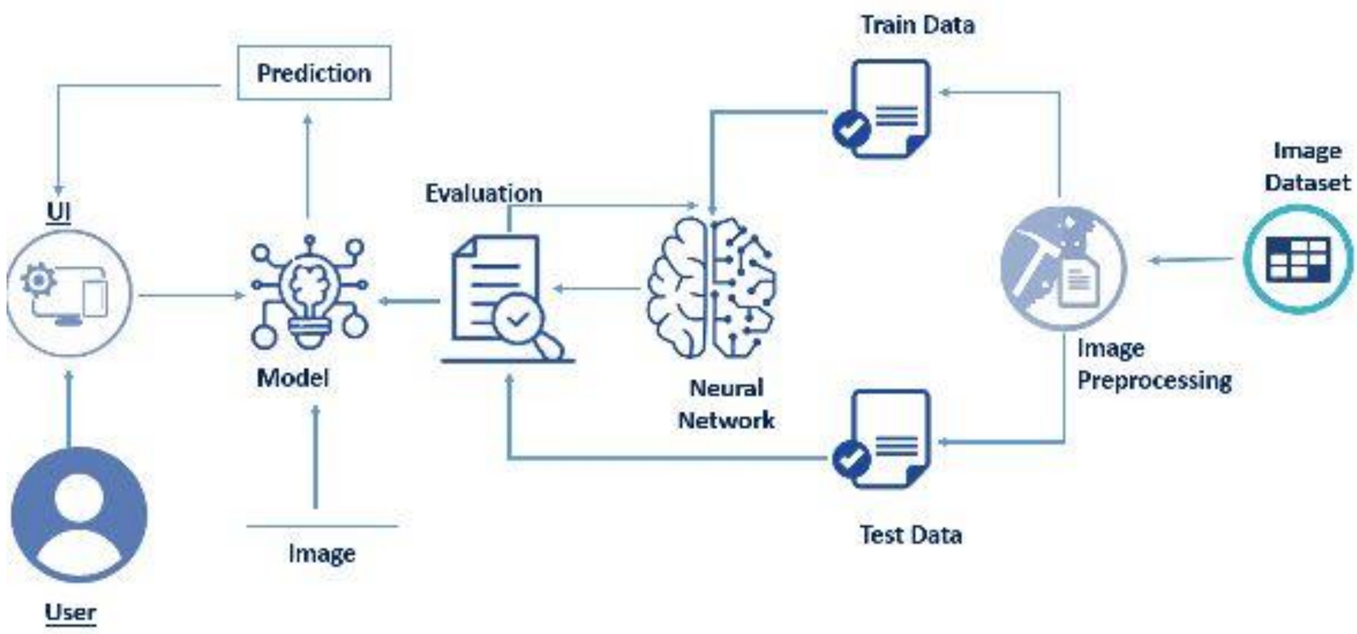
The existing problems and approaches for iceberg detection in satellite images highlight the challenges of this task. However, recent advances in machine learning and data fusion have made it possible to develop more effective and robust systems. With continued research, these systems will become even more accurate and efficient, making it possible to better protect people and the environment from the hazards posed by icebergs.

Here are some additional thoughts on the existing problems and approaches for iceberg detection in satellite images:

- The use of feature extraction can be a helpful way to reduce the dimensionality of the data and to identify features that are most discriminative of icebergs.
- Machine learning algorithms can be used to learn the relationships between features and icebergs. This can help to improve the accuracy of iceberg detection.
- Data fusion techniques can be used to combine information from different sources to improve the accuracy of iceberg detection.

3. THEORITICAL ANALYSIS

3.1 BLOCK DIAGRAM:



3.2 HARDWARE / SOFTWARE DESIGNING:

Hardware Requirements:

- *Processor*: i5, i7, Ryzen 5, Ryzen 7
- *Ram*: 8 GB
- *Hard Disk*: 120 GB

Software Requirements:

- *Operating System*: Windows 8/10/11
- *Figma*
- *Visual Studio Code, PyCharm,*
- *Google Collaboration.*

Technologies Used:

HTML, CSS, Java Script, Python, TensorFlow, NumPy, pandas, Neural Network, flask, jQuery,

4. EXPERIMENTAL INVESTIGATIONS

Some experimental investigations that have been made while working on the solution for iceberg detection in satellite images:

FEATURE EXTRACTION: One of the first steps in iceberg detection is to extract features from satellite images that can be used to distinguish icebergs from other objects in the environment. These features can include the shape, size, and texture of the iceberg, as well as the brightness and contrast of the image.

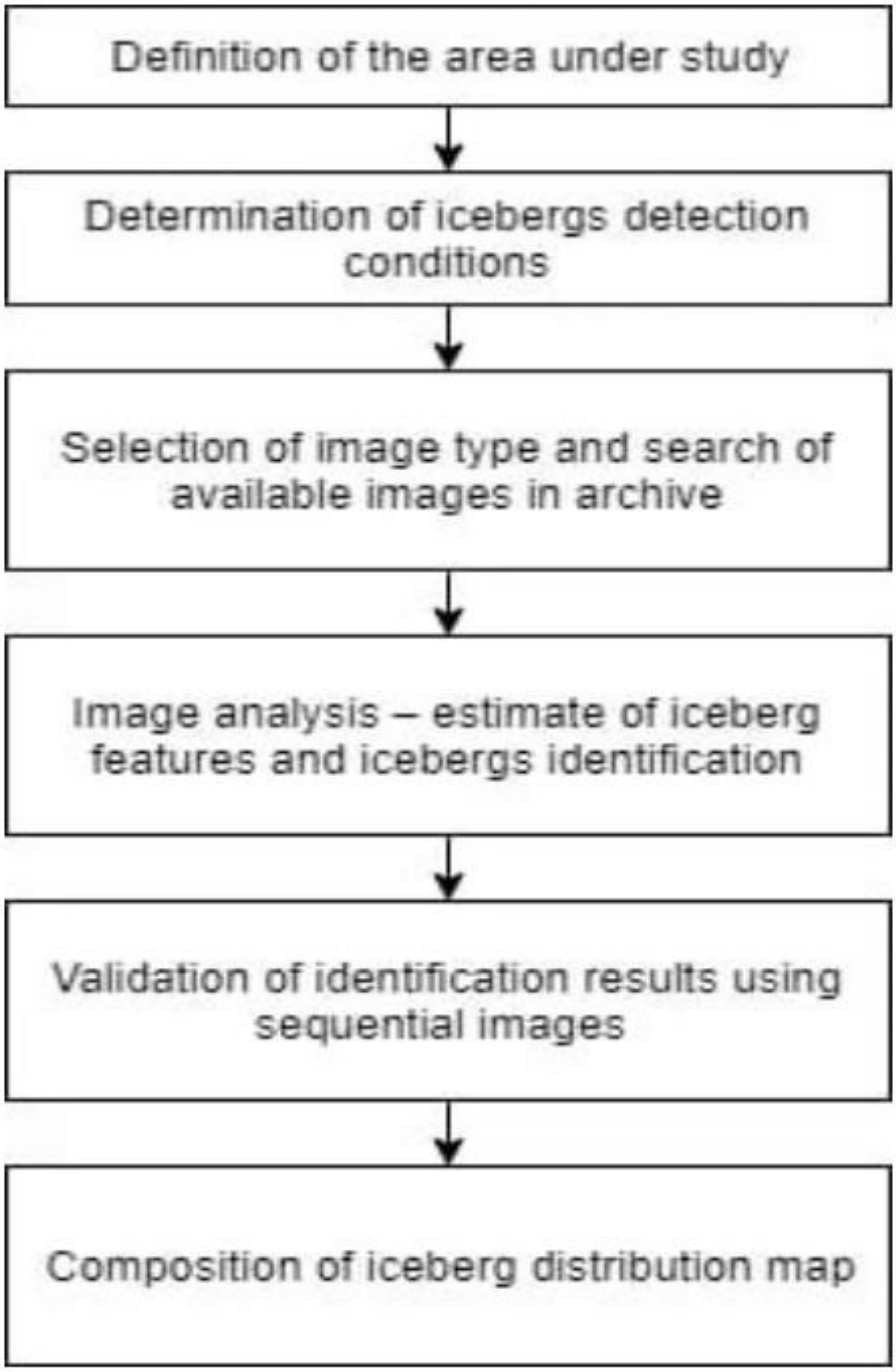
CLASSIFICATION: Once features have been extracted, they can be used to classify images as containing an iceberg or not. This can be done using a variety of machine learning techniques, such as support vector machines, random forests, and deep learning.

ROBUSTNESS: It is important for iceberg detection systems to be robust to different conditions, such as different lighting conditions, different types of icebergs, and different types of satellite images. This can be achieved by using a variety of features and by training the classification models on a large dataset of images.

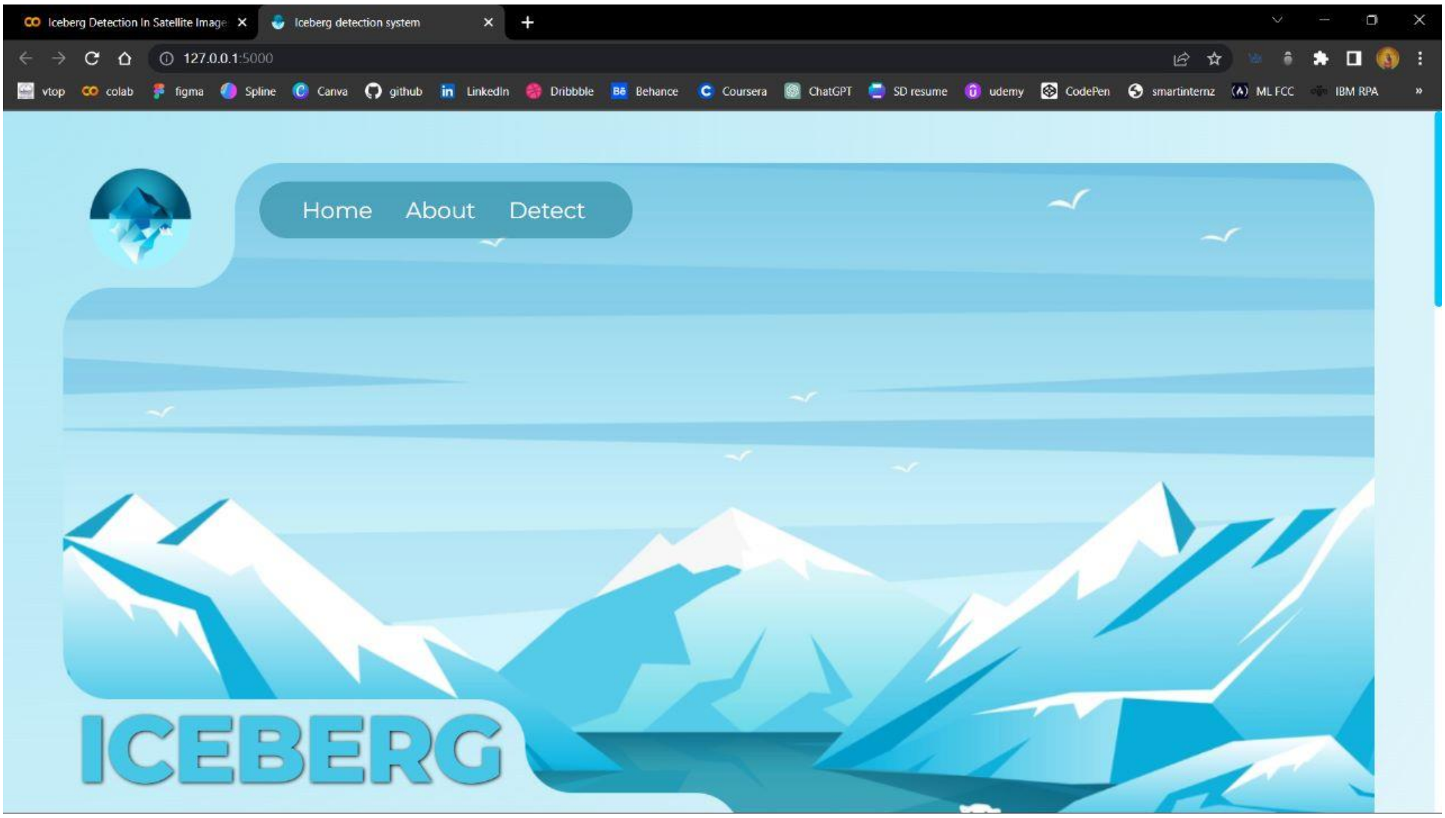
REAL-TIME DETECTION: In order to be effective, iceberg detection systems need to be able to detect icebergs in real time. This can be achieved by using fast machine learning algorithms and by deploying the systems on high-performance computing platforms.

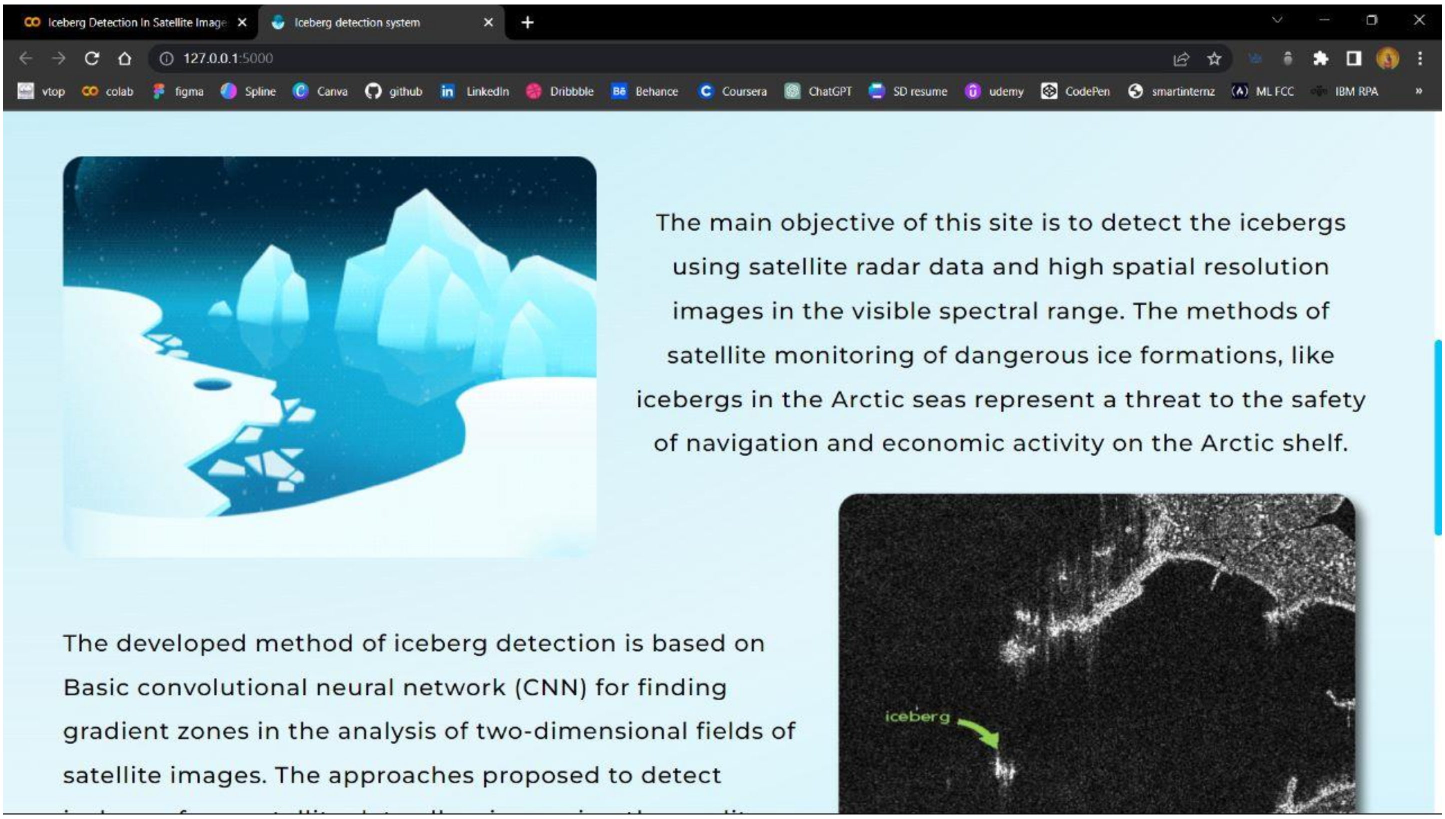
Overall, this experimental investigation helped us to develop an accurate model for detecting the iceberg using Convolutional Neural Networ

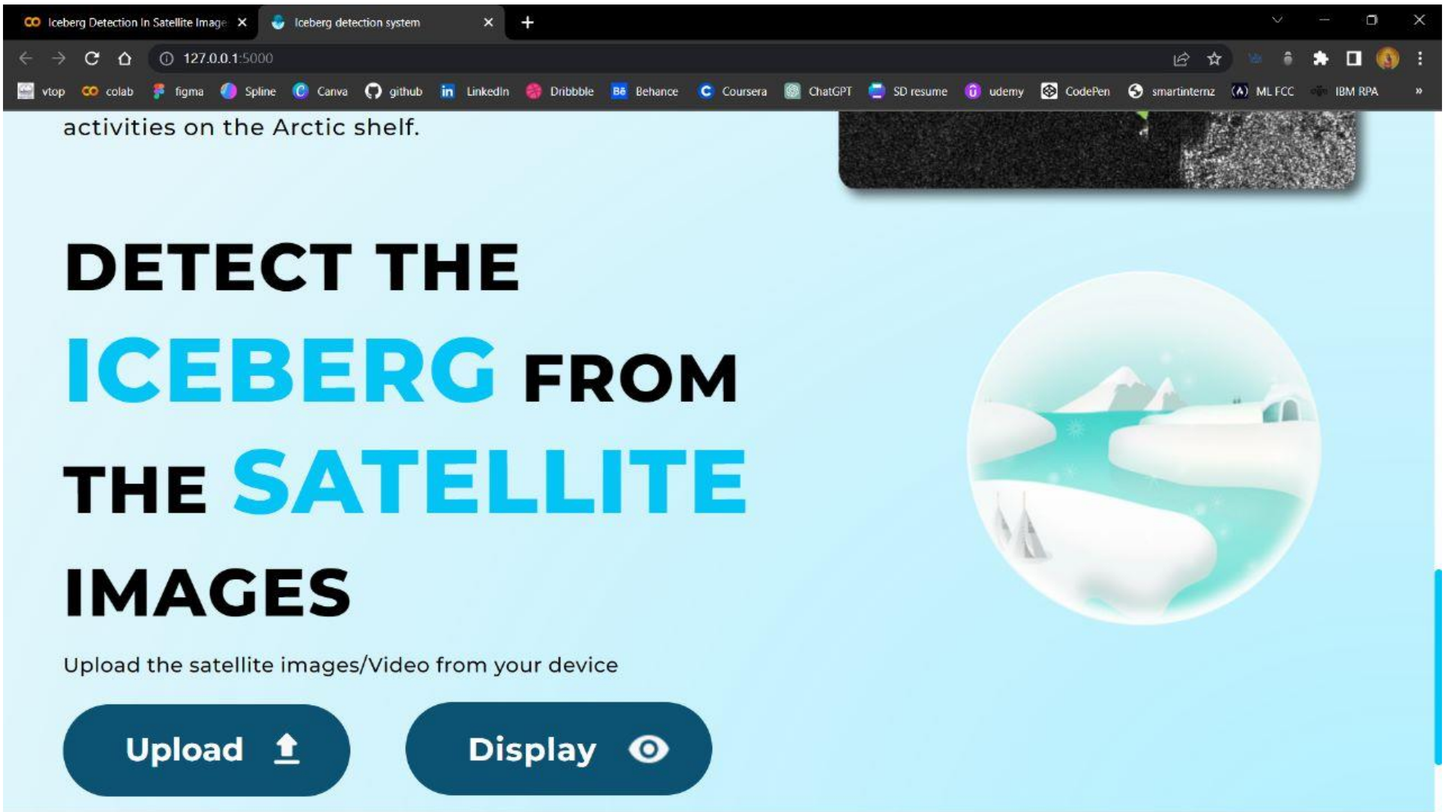
5. FLOWCHART

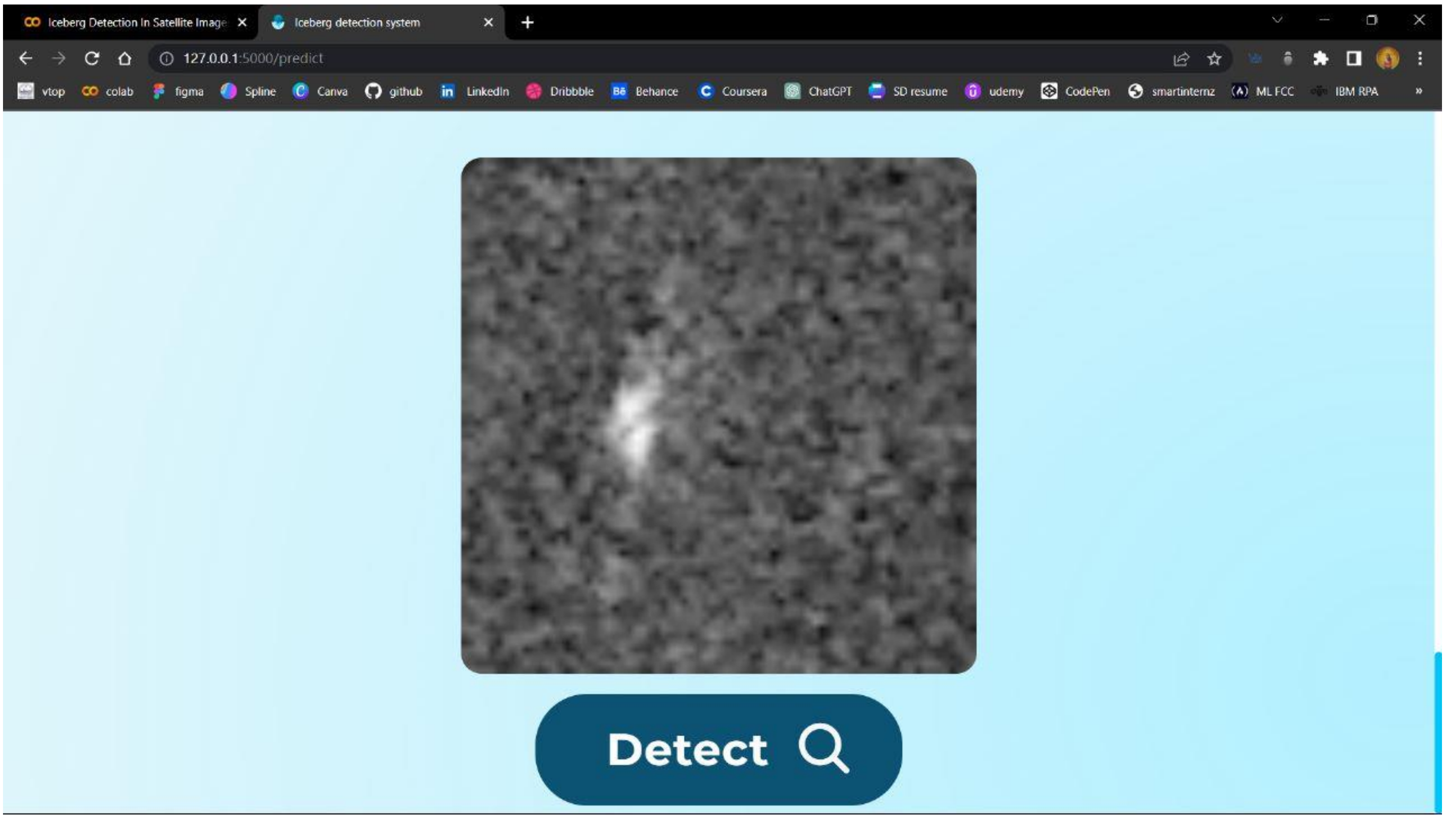

Definition of the area under study
Determination of icebergs detection conditions
Selection of image type and search of available images in archive
Image analysis – estimate of iceberg features and icebergs identification
Validation of identification results using sequential images
Composition of iceberg distribution map

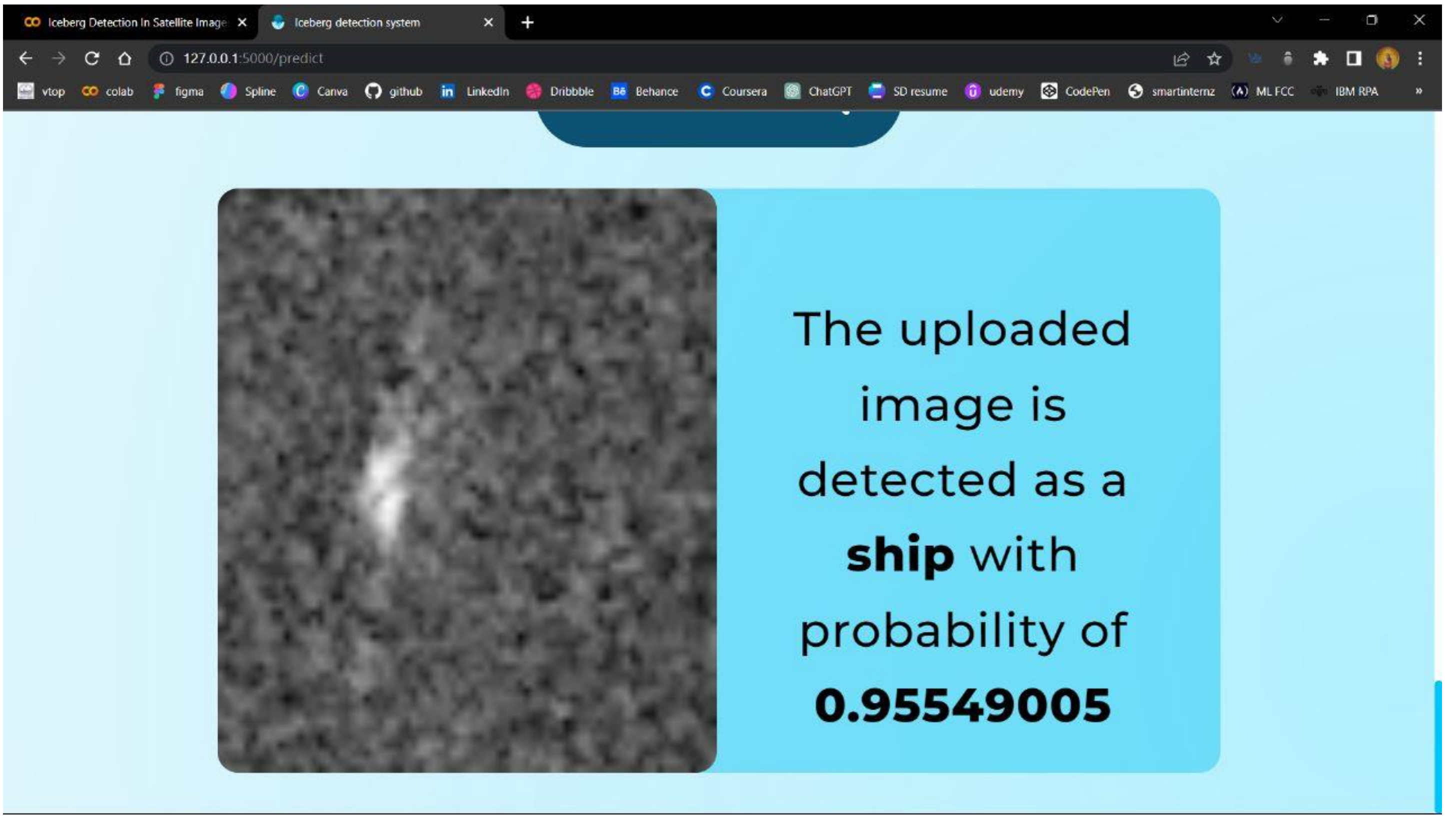
6. RESULT


Iceberg Detection In Satellite Image
Iceberg detection system
127.0.0.1:5000
vtop
colab
figma
Spline
Canva
github
LinkedIn
Dribbble
Behance
Coursera
ChatGPT
SD resume
udemy
CodePen
smartinternz
ML FCC
IBM RPA
Home
About
Detect
ICEBERG


Iceberg Detection In Satellite Image
Iceberg detection system
127.0.0.1:5000
The main objective of this site is to detect the icebergs using satellite radar data and high spatial resolution images in the visible spectral range. The methods of satellite monitoring of dangerous ice formations, like icebergs in the Arctic seas represent a threat to the safety of navigation and economic activity on the Arctic shelf.
The developed method of iceberg detection is based on Basic convolutional neural network (CNN) for finding gradient zones in the analysis of two-dimensional fields of satellite images. The approaches proposed to detect
iceberg


Iceberg Detection In Satellite Image
Iceberg detection system
127.0.0.1:5000
activities on the Arctic shelf.
DETECT THE
ICEBERG FROM
THE SATELLITE
IMAGES
Upload the satellite images/Video from your device
Upload
Display


Iceberg Detection In Satellite Image
Iceberg detection system
127.0.0.1:5000/predict
Detect



7. ADVANTAGES AND DISADVANTAGES:

ADVANTAGES:

- **WIDE COVERAGE:** Satellites can provide coverage of a wide area, which is important for detecting icebergs in remote or difficult-toreach locations.
- **CONTINUOUS MONITORING:** Satellites can monitor icebergs 24/7, regardless of weather conditions. This can help to ensure that icebergs are detected and tracked in a timely manner.
- **AUTOMATED DETECTION:** Satellite images can be used to automate the detection of icebergs, which can save time and resources. This is especially beneficial for large-scale operations, such as shipping or oil and gas exploration.
- **HIGH ACCURACY:** Satellite images can provide high-resolution images of icebergs, which can be used to accurately assess their size, shape, and location. This information can be used to make informed decisions about safety and navigation.
- **COST-EFFECTIVENESS:** Satellite imagery is a relatively cost-effective way to monitor icebergs over a large area.

DISADVANTAGES:

- **CLOUD COVER:** Satellite images can be obscured by cloud cover, which can make it difficult to detect icebergs.
- **WEATHER CONDITIONS:** Satellite images can be affected by weather conditions, such as fog or rain. This can make it difficult to accurately assess the size, shape, and location of icebergs.
- **COST:** The cost of satellite imagery can be high, especially for high-resolution images.
- **TECHNICAL CHALLENGES**: There are some technical challenges associated with using satellite imagery for iceberg detection, such as identifying icebergs in a cluttered background and distinguishing between icebergs and other objects, such as ice floes or ships.

8. APPLICATIONS

There are many applications of iceberg detection using satellite images. Some of the most common applications include:

- **SHIPPING SAFETY:** Satellite images can be used to detect icebergs in shipping lanes and other areas where ships are likely to travel. This information can be used to issue iceberg warnings to shipping vessels and help to prevent collisions.
- **OIL AND GAS EXPLORATION:** Satellite images can be used to detect icebergs in areas where oil and gas exploration is taking place. This information can be used to assess the risk of icebergs to offshore drilling platforms and other infrastructure.
- **MILITARY OPERATIONS:** Satellite images can be used to detect icebergs in areas where military operations are taking place. This information can be used to assess the risk of icebergs to ships, aircraft, and other personnel.
- **CLIMATE CHANGE RESEARCH:** Satellite images can be used to track the movement of icebergs and assess the impact of climate change on iceberg formation and melt rates. This

information can be used to improve our understanding of climate change and its impacts.

- **TOURISM:** Satellite images can be used to track the movement of icebergs and identify areas where icebergs are likely to be visible from shore. This information can be used to help tourists plan their trips and increase their chances of seeing icebergs.

9. CONCLUSION

Iceberg detection in satellite images is a challenging task, but recent advances in machine learning have made it possible to develop automated systems that are more accurate and efficient than traditional methods. These systems can help to prevent collisions between ships and icebergs, as well as monitor the movement of icebergs and track their impact on the environment. The development of automated iceberg detection systems is a promising area of research with the potential to make a significant impact on maritime safety and environmental monitoring

10. FUTURE SCOPE

- The scope of iceberg detection using satellite images is vast. Satellites can provide coverage of a wide area, regardless of weather conditions, and can be used to detect icebergs in remote or difficult-to-reach locations. This makes them an essential tool for safety and navigation in areas where icebergs pose a risk.
- Satellite images can be used to detect icebergs of all sizes, from small icebergs that pose a threat to ships to large icebergs that can block shipping lanes or cause damage to coastal infrastructure. They can also be used to track the movement of icebergs, which can help to predict where they may pose a threat in the future.
- The use of satellite images for iceberg detection is becoming increasingly widespread. As satellite technology continues to improve, it is likely that the use of satellite images for iceberg detection will become even more effective and efficient in the future.

Here are some specific examples of how satellite images are being used to detect icebergs:-

- The European Space Agency (ESA) uses satellite images to detect icebergs in the Greenland Sea. The ESA then provides this information to the Danish Meteorological Institute, which uses it to issue iceberg warnings to shipping vessels.
- The National Aeronautics and Space Administration (NASA) uses satellite images to detect icebergs in the Antarctic Ocean. NASA then provides this information to the National Ice Center, which uses it to issue iceberg warnings to shipping vessels.

The use of satellite images for iceberg detection is an important safety measure that helps to protect people and property from the risk of iceberg collisions. As satellite technology continues to improve, it is likely that the use of satellite images for iceberg detection will become even more widespread.

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APPENDIX

A. Source Code

MODEL

```
!unzip/content/drive/MyDrive/Colab/smartBridge/Iceberg_Detection_dataset   20230620T151617Z-
    001.zip
from tensorflow.keras.preprocessing.image import ImageDataGenerator
train_gen = ImageDataGenerator(rescale = 1./255,
shear_range = 0.2,
zoom_range = 0.2,
horizontal_flip = True)
test_gen = ImageDataGenerator(rescale = 1./255)
train = train_gen.flow_from_directory('/content/Iceberg Detection dataset/dataset/train',
 target_size=(75, 75),
 class_mode='binary',
batch_size=32)
test = test_gen.flow_from_directory('/content/Iceberg Detection dataset/dataset/test',
target_size=(75, 75),
 class_mode='binary',
batch_size=32)
train.class_indices
from tensorflow.keras.layers import
Convolution2D,MaxPooling2D,Flatten,Dense,Dropout,BatchNormalization
from tensorflow.keras.models import Sequential
model=Sequential()
 # CNN 1
model.add(Convolution2D(64, kernel_size=(3, 3),activation='relu', input_shape=(75, 75,
3)))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(3, 3), strides=(2, 2)))
model.add(Dropout(0.2))
 # CNN 2
model.add(Convolution2D(128, kernel_size=(3, 3), activation='relu' ))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(3, 3), strides=(2, 2)))
model.add(Dropout(0.2))
```

```
# CNN 3
model.add(Convolution2D(128, kernel_size=(3, 3), activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(3, 3), strides=(2, 2)))
model.add(Dropout(0.2))
# CNN 4
model.add(Convolution2D(64, kernel_size=(3, 3), activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(3, 3), strides=(2, 2)))
model.add(Dropout(0.2))
# You must flatten the data for the dense layers
model.add(Flatten())
# Dense 1
model.add(Dense(512, activation='relu',input_shape=(257,)))
model.add(Dropout(0.2))
# Dense 2
model.add(Dense(256, activation='relu'))
model.add(Dropout(0.2))
# Output
model.add(Dense(1, activation="sigmoid"))
# Final model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
model.fit(train, epochs=100, validation_data=test)
train_score=model.evaluate(train)
test_score=model.evaluate(test)
model.save("/content/drive/MyDrive/Colab/iceberg1.h5")
import numpy as np
from tensorflow.keras.preprocessing import image
img = image.load_img('/content/Iceberg Detection
dataset/dataset/test/Iceberg/f325.png',target_size=(75,75))
def predict(img):
 img = image.img_to_array(img)
img = np.expand_dims(img,axis=0)
if(np.max(img)>1):
```

```
img = img/255.0
 pred = np.array(model.predict(img)>0.5)
if(pred):
output = "ship"
 else:
output = "iceberg"
return output
     predict(img
```