

IDENTIFY THE FLOODED AREA USING DEEP LEARNING

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in Information Technology

By

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INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade "A" by NAAC

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MARCH - 2021

DECLARATION

I **EMMANUEL CHARLES .S** hereby declare that the Project Report entitled **IDENTIFY THE FLOODED AREA USING DEEP LEARNING** done by me under the guidance of Dr. **R.JEBERSON RETNA RAJ** (Internal) is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering / Technology degree in **INFORMATION TECHNOLOGY**.

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **S.EMMANUEL CHARLES (37120026)**, **M.MOHAMED AYMAN LATHEEF (37120044)** who carried out the project entitled **"IDENTIFY THE FLOODED AREA USING DEEP LEARNING"** under my supervision from November 2019 to April 2020.

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ABSTRACT

In recent year we can see most of the areas especially in the city side we can see most of the building were still constructing and giving the approval to live but due to some reason, most of them were constructed the building in the flooded area these results people who are living in that building as well as in that particular area were affected by flood during the rainy season. Since most of the people don't have prior knowledge about the particular area whether it is affected by the flood or not. This project is aimed mainly at identifying the flooded area using deep learning. By using these data we can alter the people who are living in that particular area during the flooded time as well it will help the people to identify the suitable areas to construct the building without affecting by the flood.

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LIST OF ABBREVIATIONS

ABBREVIATIONS

EXPANSION

RGB	Red Green Blue
NDVI	Normalized Difference Vegetation Index
VARI	Visible Atmospherically Resistant Index
PCA	Principal Component Analysis
CNN	Convolution Neural Network
GDAL	Geospatial Data Abstraction Library
NDMI	Normalized Difference Moisture Index

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In today's world almost every country where facing various types of natural disasters such as Landslide, Earthquakes, Hurricanes, Tsunamis, Lightning, Tornadoes, Volcanic eruption, etc these are some natural disaster which causes huge damages to people all over the world. One of the most dangerous disasters that most of the world faces is the river flood. Every year almost 21 million people around the world were affected due to floods. Countries like Bangladesh, India, China, Indonesia, Egypt, Thailand, Brazil, Afghanistan, Iraq are the countries that were most affected by the river flood. A flood is an overflow of water on the dry ground that submerges the land that usually dry. Flood is caused due to heavy rainfall in the areas of the rivers and the poorly drained areas. When the level of the water rises above the river banks or dams the water started to overflow to areas adjoining the rivers, dams or lakes causes a flood.

Flood is differentiated into four types they are Flash flood, Coastal flood, Urban flood, River flood, and Ponding these are the five major types of flood. Flash flood is a rapid flooding of low-lying areas, It may be caused by heavy rain associated with a severe thunderstorm, hurricane, tropical storm, or melt-water from ice or snow flowing over ice sheets or snowfields. Coastal floods are one of the types of flooding it normally occurs in the coastal areas as the sea level rises, at the time of heavy rain it causes the flood. Urban flood is a type of flood that happens in urban areas. It happens when a river overflows its banks or when a hurricane drives a storm surge across a coastal it is caused by excessive runoff in developing areas when water does not have anywhere to go. River floods are caused when there a sudden rise in water level in river or dam or lake and other water resources during heavy rain. Ponding is a type of flood that happens in flat areas where the rainwater is fallen in an area where normally store the water in the ground or canals, or lakes are drained away or pumped out when more rainfall enters into the water system when it reaches the maximum level at that time the

flood occurs. Flood mainly cause great damage to people who live in the lower level such as the areas which is near to the river flowing area or place where lakes are situated or near the dam. These areas were facing high damages during the time of the flood. In some surveys say that changing the land level or covering the river path or lake which are dry for many years for constructing industries or apartments these might affect the people who live in that area in the time of the flood. These are some reasons when a flood occurs in developed as well as in developing countries. Flood occurring areas are cannot be analyse since each and every year

1.2 OUTLINE OF THE PROJECT

Identifying the flood area is very helpful to the people who need to know about the particular area because most of the building were constructed in the area like rive path or lakes which are dry over many year that particular were affected during heavy rain and there might be a chance of occur flood. Since most of the people might doesn't have the prior knowledge about the particular area whether is affected by the flood or not. This project it helps to identify the particular area is safe to live or safe construct.

This project will identify the low level area as well as high level area by using the satellite image of different band set of that particular area with same dimension. It also identify or check whether there is any river path or other water reservoirs where located in that particular area. With it help of the algorithm deployed in the project it provides a clear information about the particular area in a form of graphical representation and it judge whether the particular area is safe from flood or not. This project visualize each data in different color for the people to understand. This information will provide a better understanding about the particular area whether it is possible that area might affected by the flood or not, Identify the river path or other water reservoirs which is not clearly identified. It clearly differentiate low level areas as well as high level area since people living in the low level areas were mostly affected by the flood whereas the people living in the high level area were not affected by the flood frequently.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

A literature review is a body of text that aims to review the critical points of current knowledge on and/or methodological approaches to a particular topic. It is secondary sources and discuss published information in a particular subject area and sometimes information in a particular subject area within a certain time period. Its ultimate goal is to bring the reader up to date with current literature on a topic and forms the basis for another goal, such as future research that may be needed in the area and precedes a research proposal and may be just a simple summary of sources. Usually, it has an organizational pattern and combines both summary and synthesis

2.2 REVIEW OF THE LITERATURE SURVEY

Title : Application of satellite image processing and GIS-Spatial modeling for mapping urban areas prone to flash floods in Qena governorate, Egypt

Author : Soha A. Mohamed

Year : 2019

The flow direction, streams order, and watersheds are derived from Advanced Space-borne Thermal Emission and Reflection Radiometer DEM with 30 × 30 m spatial resolution. To derive the hydro-logical parameters, ASTER(Advanced Space-borne Thermal Emission) and DEM grid were input into the ArcGIS. Land cover is considered a crucial parameter to understand the distribution and dynamics of urban growth. Land cover referred to the physical land type refers to agriculture, urban and built-up infrastructure, water, stony areas, and limestone, etc. Image processing in this study includes layer stacking to combine seven bands from band 1 to band 7 together into a single image. The two Landsat

scenes are cover the whole study area. Then, the image is clipped to get an image subset matching the administrative boundary of the study area. Supervised image classification is used to derive the available land cover types. Several polygons are used as training areas to extract land cover.

Training areas are performed to all land cover classes using ground truth data and google earth. Many training areas were used to represent each land cover type. The training samples are saved as a supervised signature file. Separability analysis including the mean plot and the divergence matrix are used to evaluate and examine whether the supervised signatures are separable or not. The maximum likelihood classification (MLC) algorithm is applied for accurate land cover extraction. Accuracy assessment or validation is a significant step to validate and evaluate the process of image classification. Ground truth data, google earth and digital globe are used testing points to assess the accuracy of supervised classification.

Title : River Flooding Forecasting and Anomaly Detection Based on Deep Learning

Author : Scott miao and Wei-hsi hung

Year : 2020

Deep learning methods, such as CNN and LSTM, are widely used in many fields. We used deep learning models for multiple time step forecasting. In past studies, different comparisons indicated that each NN has the ability to capture the time-dependent characteristics of river water levels, but the optimal parameter configuration for each model was still unspecified. Therefore, the first step of our experiment was to find out the optimal parameter configuration of each model through comparisons among different parameters, which was followed by a comparison of the predictive performance of each model. In this study, the results provided by CNN and LSTM had a smaller prediction error than ANN.

In terms of the LSTM model, it could forget useless information through the forget gate and learn useful information from historical data over time through memory units. Based on this result, the LSTM model could make use of long-term

dependencies to produce accurate water level predictions. As for the CNN model, due to its abilities to extract the patterns of local trends and catch the same patterns occurring in different regions, it performed well in the water level prediction of our experiment. For further improvements in the accuracy and stability of water level prediction, we proposed a new deep neural network framework that integrated CNN modules with GRU modules. GRU is relatively new, and its performance is comparable to LSTM but has higher computational efficiency

Conv-GRU model had outperformed the other four models. Individual single CNN and GRU models are not very good in predicting performance, but if the advantages of the two models are combined, we propose an integrated model, the prediction performance is better than individual single network models. Because of the integration of the hidden features from CNN and GRU, the proposed model could be more effective and stable in water level prediction. This result demonstrated that the integrative model had better stability than the stand-alone model and also gave a new research direction for timing prediction based on the fusion of GRU and CNN. In the future, more studies could focus on the improvement of accuracy in short-term river level predictions by integrating the hidden features of GRU and CNN more efficiently.

Title : Deep Learning for Flood Forecasting and Monitoring in Urban Environments

Author : Charalampos Karyotis, Tomasz Maniak, Faiyaz Doctor, Rahat Iqbal, Vasile Palade, Raymond Tang

Year : 2019

Rainfall intensity, which can be defined as the ratio of the total amount of rain falling during a given period to the duration of that period. High intensity rainfall could result in huge peaks of water in an area. Storm duration: Given rainfall intensity, the amount of water that is going to fall on an area is a direct function of the storm's duration. Most flooding is related to slow-moving storms and to storms which are repeatedly moving over the same area. However, flooding may occur within few minutes of excessive rainfall, demonstrating the importance of

incorporating other factors. Drainage flow and water depth: the water levels in the drainage and the capacity of the drainage system as well as the interaction between surface and sewer water flow are critical factors in the formation of urban flooding phenomena. Temperature: high temperature impacts upon the creation of clouds and rainfall, especially for summer thunderstorms. The convective precipitation intensifies far more quickly at elevated temperatures. Relative Humidity: which is the amount of moisture in the air, compared to what the air can "hold" at a given temperature. Rain forms when relative humidity is 100%, and the temperature is the dew point. Soil absorption: that is the process by which water on the surface enters the soil and demonstrates the soils ability to absorb rainfall. Different types of soil have different rates of soil infiltration, and this rate decreases as the soil becomes saturated.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM

- Identify the low-level areas as well as high-level areas
- Identify the river path and other water resources
- Analyze the particular land might face some serious damages due to flood.

3.2 SCOPE

The scope of the project is to identify the features of the land using the satellite image. Such as identify the low-level areas as well as high-level areas, Identify the river path and other water resource areas. Because the floods like river floods, coastal floods, and ponding are frequently happening in these areas and causing high damages.

3.3 EXISTING SYSTEM

Most existing systems are designed for identifying the river flood damages or damages caused by the coastal flood or damages caused by the ponding. Since these are most frequent flood happens in most of the countries like India, China, Bangladesh, Nepal, and other countries who faces the frequent river flood damages for every year. These existing systems still used the satellite image to identify the flood damages and predict some damage values and compare the damages with real-time damage surveys. Since flood damages increase year by year there lot of reasons behind it for example changes in low-level areas, covering the river path or other water reservoir areas which are dry for many years these are some major reasons why the flood damage rate increase year by year.

In most existing system uses the earthquake damage rate concept for the urban flood projects since the urban flood is unpredictable. So most of the existing system uses the damage rate of the earthquake as the Urban flood damage rate.

The most existing system uses the rasterio python packages for raster the image given as input. In some existing system uses the Thermal Emission and Reflection Radiometer DEM with 30×30 m spatial resolution. To derive the hydrological parameters, ASTER and DEM grid were inputted into the ArcGIS. Land covers are considered a crucial parameter to understand the distribution of urban growth. Land cover referred to the physical land type such as agriculture, built-up infrastructure, and urban area water, stony areas, and limestone, etc. And the ANNs method is widely used in ML due to its accuracy and high power parallel processing deals with complex flood functions, especially where datasets are improper or incomplete. The sources of data-set are traditionally rainfall, and water level, measured either by ground rain gauges, or relatively new remote sensing technologies of satellites like multi-sensor systems, or radars. Remote sensing is an attractive tool to capture higher resolution data in real-time and the high resolution of weather radar observations provides a more reliable data-set comparing to rain gauges. Thus building a prediction model upon radar-based rainfall data-set reported providing higher accuracy in general.

CHAPTER-4

METHODOLOGY

4.1 HARDWARE AND SOFTWARE REQUIREMENTS

Operating System : Windows

Tools : Anaconda with jupyter Notebook/ jupyter lab

Processor : intel i3, i5, i7 or Pentium 4/5

Hard disk : Minimum 80 GB

RAM : Minimum 8GB

Input : Satellite images (.tif or .tiff format)

Language : Python

4.2 WORKING PROCESS

This project works with a satellite image of the different band sets of the particular region as an input to this project. Remember the dimension of the satellite band images should be the same size. And the satellite image should be in the same format as well as in the same image. The band should consist of 1 to 12 images in the same format as well in the same dimension. Once the input file path is set it is sorted in ascending order (For Example 1,2,3,...12 bands). Now the Rasterio python package is used to identify the shape as well as to identify whether the dimension of all the input is in the same order. Since the Rasterio is special for raster processing which can use for reading and writing several different raster formats in python. The most important about the Rasterio is that it is based on GDAL and it also reads and writes the geospatial raster data. Now to work with satellite images, all the images should be re-sized in some particular size since the input image might be a different size that makes it more difficult to identify the features in the image. Hence the input images are re-sized in a

particular size. Now to detect the real aerial image from a given satellite image we use the RGB to apply it on the satellite image to get the clear aerial image from the give satellite image.

Now identify the colors of the different band range in each band set this helps to identify which band set has more range it just to identify the band range. Now we use the NDVI (Normalized Difference Vegetation Index) to check the vegetation area present in the particular region. Mostly NDVI (Normalized Difference Vegetation Index) is used to determine the density of the green on the patch of land. Most Researches observe the distinct colors of the visible and near-infrared sunlight reflected by the plants. For this project, we use the NDVI (Normalized Difference Vegetation Index) for differentiating the land as well as the water resource area like rivers, dams, lakes and other water reservoirs from the below image figure 3.1 we can observe the light green indicates the vegetation areas whereas the dark green indicates the water resource areas. But we can observe almost 80% of the accuracy since the aim is to differentiate the land area as well as the water resource areas. But the project aims to identify the low-level areas and the high-level area by using the NDVI(Normalized Difference Vegetation Index) we can collect the details of the land areas and the water areas. NDVI(Normalized Difference Vegetation Index) is obtained by using the normalization difference $(\text{band } 8 - \text{band } 4) / (\text{band } 8 + \text{band } 4)$ where band 8 indicates the NIR and band 4 indicates the Red.

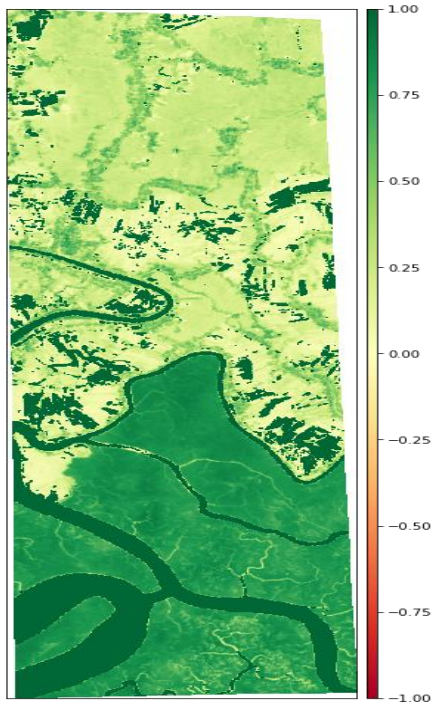


Fig 4.1 NDVI

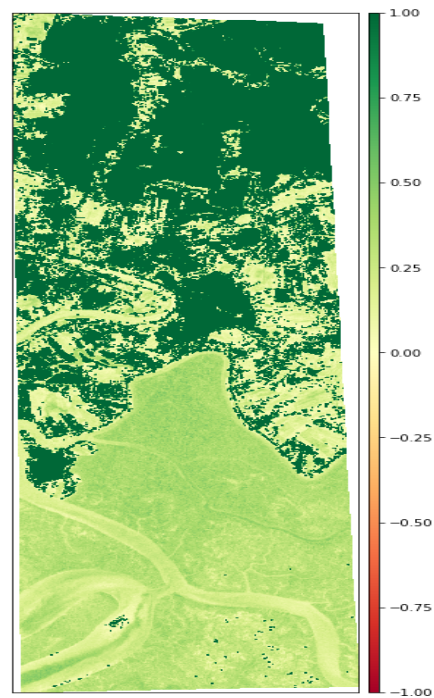


Fig 4.2 VARI

Now it identifies the high-level area we use the VARI(Visible Atmospherically Resistant Index) it is designed to emphasize vegetation in the visible portion of the spectrum while mitigating illumination differences and atmospheric effects. It is ideal for RGB or color images. This VARI (Visible Atmospherically Resistant Index) is similar to the NDVI(Normalized Difference Vegetation Index) but using the atmospheric effect we can identify the high-level area. From the above image figure 3.2, we can observe that dark green indicates the high-level area and light green indicates the water resource area. From this VARI (Visible Atmospherically Resistant Index) we can accurately identify the high-level area but sometimes in this VARI (Visible Atmospherically Resistant Index), it adds a small portion of the low-level area so the accuracy can differ at any time. The formula for VARI (Visible Atmospherically Resistant Index) is $(\text{Band 3} - \text{Band 4}) / (\text{Band 3} + \text{Band 4} - \text{Band 2})$ Band 3 indicates the Green color, Band 4 indicates the Red color and Band 2 indicates Blue color.

From NDVI (Normalized Difference Vegetation Index) and VARI (Visible Atmospherically Resistant Index), we identify the low level and high-level area in an approximate form. To identify the river path or water resource area we use the NDMI (Normalized Difference Moisture Index) is normally used to identify the crop

water stress level. Since the NDMI (Normalized Difference Moisture Index) is used to identify the moisture appears surface present as shown in fig 3.3 (For example the water resource areas such as rivers, lakes, dams, and other water reservoirs contains high moisture). NDMI (Normalized Difference Moisture Index) is obtained by a formula $(\text{Band 8} - \text{Band 11}) / (\text{Band 8} + \text{Band 11})$.

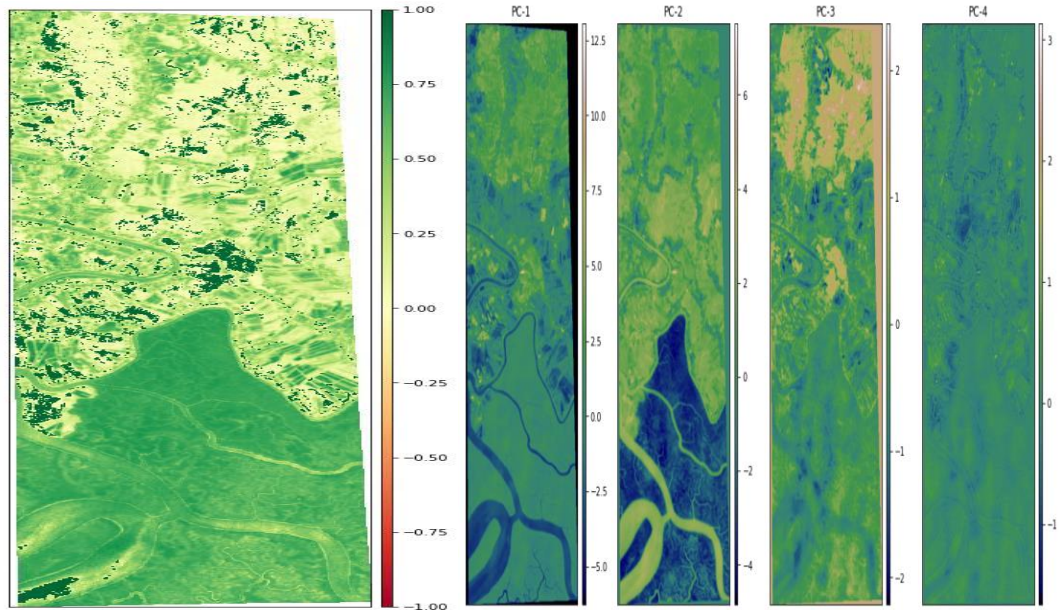


Fig 4.3 NDMI

Fig 4.4 PCA

Now PCA (Principal Component Analysis) Algorithm is used for this project mostly PCA (Principal Component Analysis) is used to shape the satellite data since the PCA (Principal Component Analysis) is a mathematical technique for reducing the dimension of the data set. we use this PCA (Principal Component Analysis) in satellite images for reducing the dimension because the satellite images are in the form of numeric. After processing the PCA (Principal Component Analysis) now the band is visualized. Due to the PCA (Principal Component Analysis) there some changes appear in the satellite bands as shown in the above image fig 3.4. Now using the K-mean Algorithm identifies the cluster values. Since K-means Algorithm is used to identify the cluster values present in the input. Now collecting the K-mean cluster value and setting each value with different colors using Visualize Cluster This visualize cluster is describe the cluster in color format.

After passing to the Visualize Cluster we send the Visualize cluster output to the CNN (Convolution Neural Network) which is trained the model with different image represent the land and the river if the Visualize cluster output satisfied with any image of the land it displays the output as land and displays the result as not possible it represents that particular area has less chance of affecting by the flood. If the Output of the Visual Cluster satisfied with images of the river. The output will display as river if the output of the CNN(Convolution Neural Network) is river condition will display as possible. It means that the particular area has more chance of affecting by the flood. This result will help the people to understand or decide about the particular land whether is safe to live in this place or it safe to construct the building in that particular area or not.

4.3 ALGORITHM AND PACKAGES

Rasterio: it is special for raster processing which can use for reading and writing several different raster formats in python. The most important about the rasterio is that it is based on GDAL and it also reads and writes the geospatial raster data.

Geopandas: is one of the open-source projects to make work with geospatial data in python. Geopandas extends the datatype of pandas(python package) to allow spatial operation on the geometric type.

Pandas: this packages are fast, flexible, and expressive data structures designed to make working with structured data like multi-dimension, tabular and time-series data both easy and intuitive. Pandas allow various data manipulation operations such as merging, reshaping, selecting and data cleaning as well as data wrapping.

Matplotlib: It is a comprehensive library for creating static, animated, and interactive visualization. Sometimes the matplotlib is also known as plotting library and it is a numerical mathematical extension of Numpy.

K-means cluster: it is a method of vector qualification, originally from single processing that aims to partition in observations into k clusters in which each observation belongs to the cluster with the nearest mean.

CNN(Convolution Neural Network): it is a deep learning neural network commonly used to analyze visual images and the frequency is work behind the scenes of image classification.

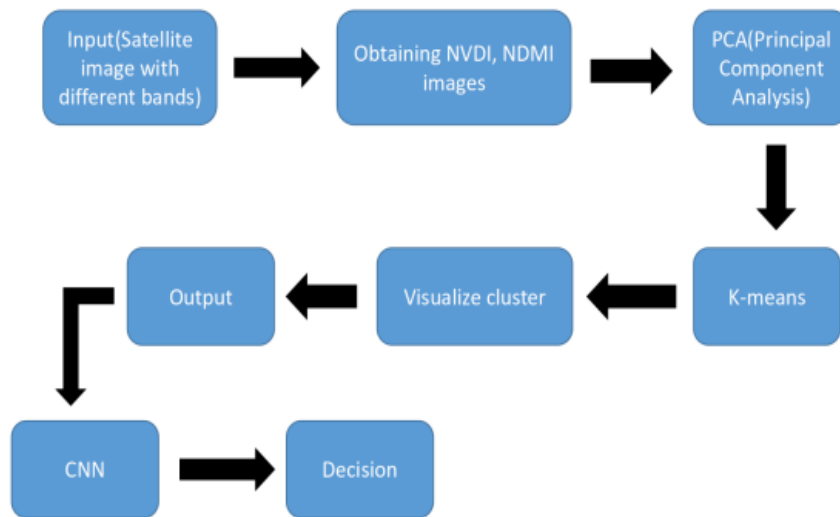


Fig 4.5 System Architecture

CHAPTER 5

RESULTS AND DISCUSSION

5.1 RESULT AND DISCUSSION

This project aims to identify the particular region is might face damages due to the flood. This project searches for some basic information from the particular region. Since most of the flood regions are happens in the areas like low-level areas, riverside or water resource areas like dams, lakes, dry lakes, etc. Such areas are frequently facing damages due to floods. This area might also face some damages during a heavy or moderate rainfall. Almost 80 to 90 percentage of the people don't have prior knowledge about the particular area whether the area was affected by the flood or whether the area was at a low level of any water resources are found near the particular area. These are basic information people will not mind before they going to live in that particular area or buying the land to construct their dream house. These results the people living in that area will affect by the flood.

This project aims at three simple pieces of information. Identify the low-level area, Identify the high-level area, Identify the water resources, and the result is trained with CNN algorithm which the result is matched with CNN trained models (I.e. river area and land area) and the final decision is given as output. This simple information will help the people without affecting by the flood. This project will work only with satellite images of the different band set from band1 to band 12 with the same dimension with the same image.

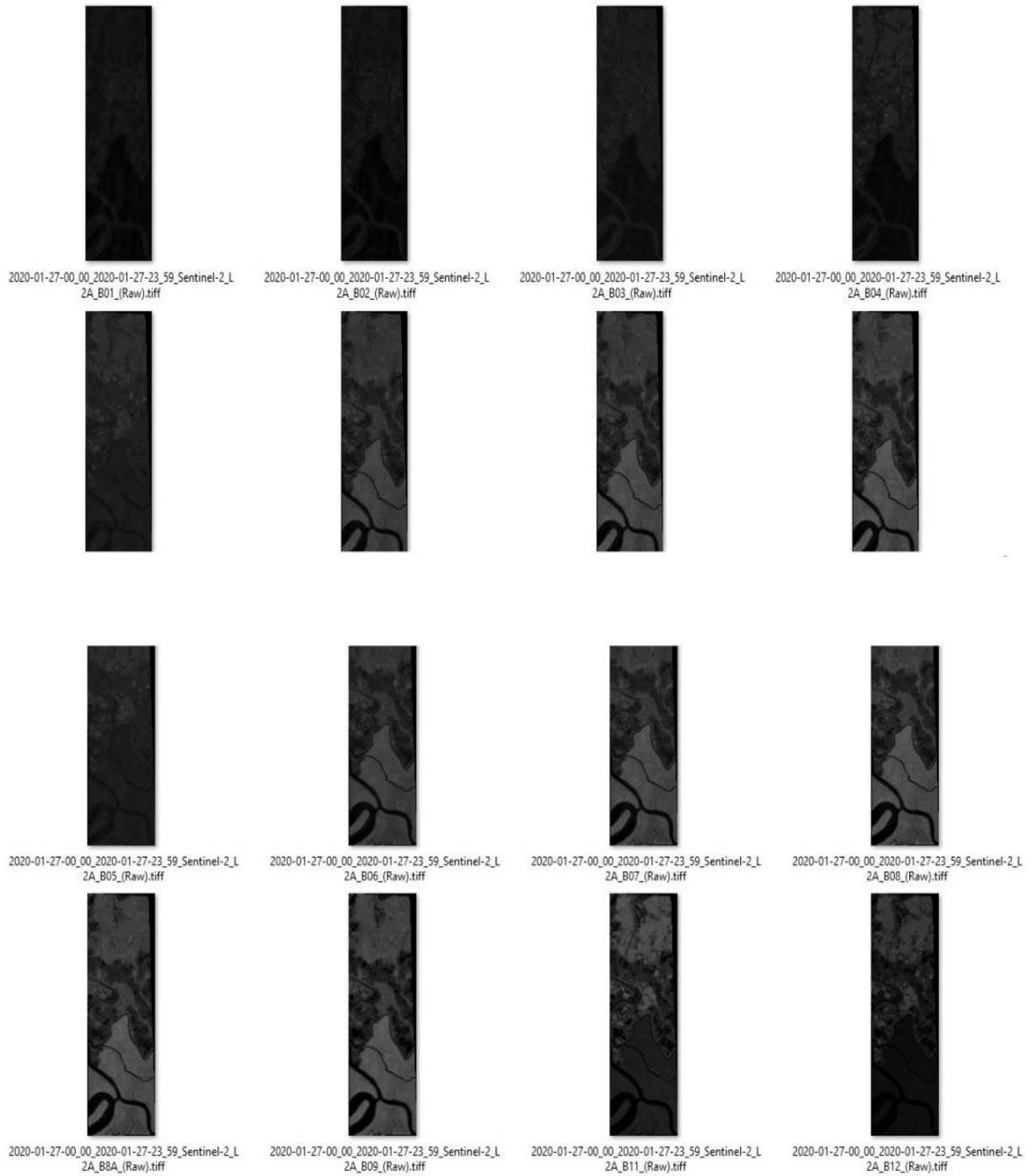


Fig 5.1 Band image (input images or source images)

The input image (12 band images in .tiff format) of same dimension are stored in a stack of n-dimension array using .stack method() function by numpy package. Then these image which are stored in the stack are read or raster with help of the reasterio package. For visualize the band image which are present in the stack we use the plot_bands() function provided by the earhpy packages by

passing the array to the parameter we can visualize the band images in infrared images format.

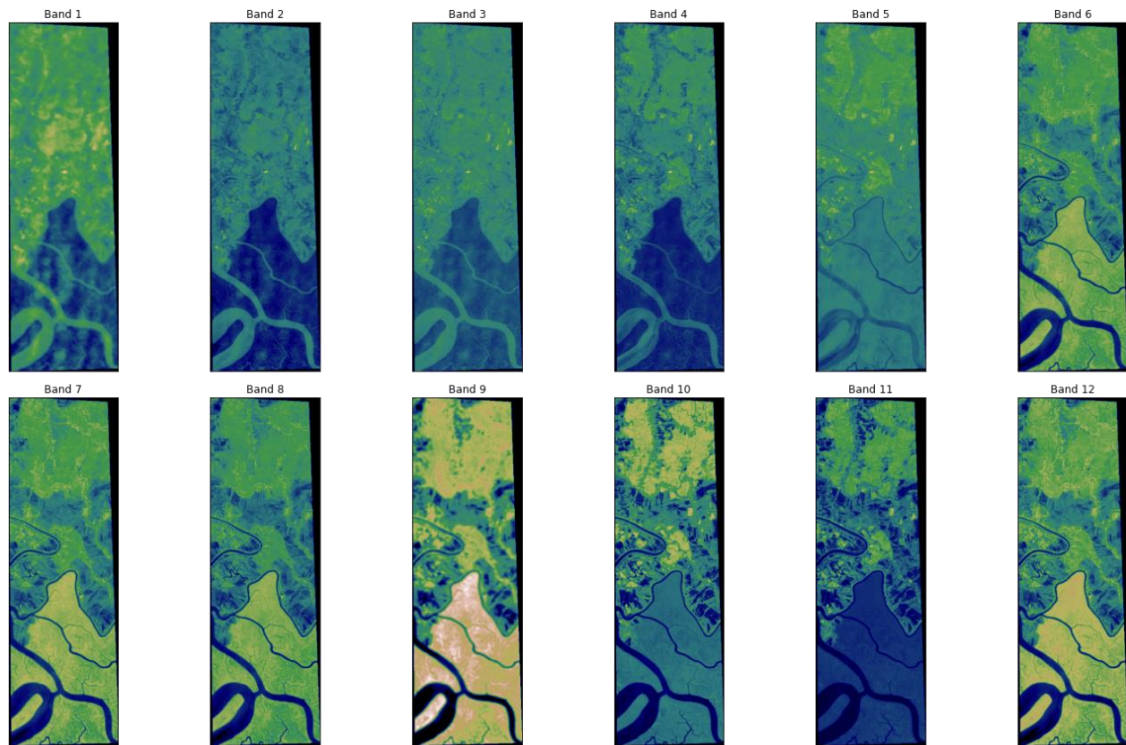


Fig 5.2 Visualizing the Band images

Next to view the band image in RGB form we use `plot_rgb()` function with the help of the `earthpy` package we can convert the band images into RGB image.



Fig 5.3 RGB image

if the RGB is not well visible we can use the stretch to brighten the RGB image.



Fig 5.4 RGB with stretch form

Next to identify the pixel value of the each band present in the array.

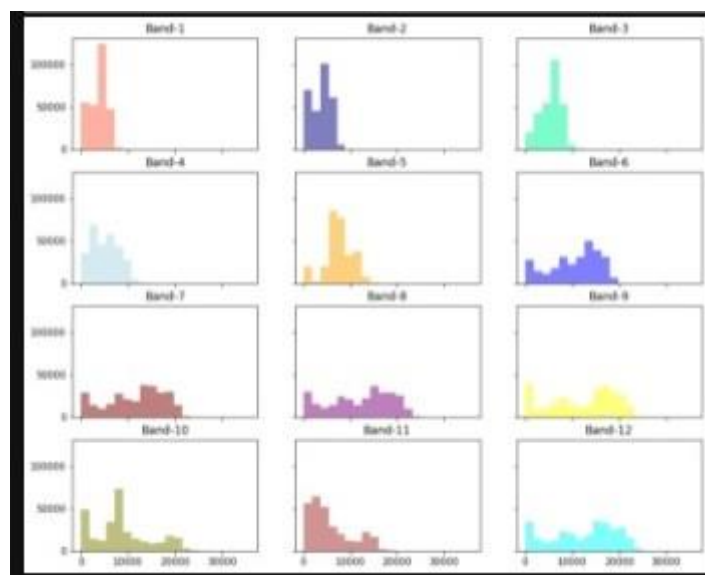


Fig 5.5 pixel value of each band

To identify the data in the high dimension it is very difficult to overcome this problem we use the PCA algorithm that transforms a high dimensional data to low dimensional data so that it can be visualized easily.

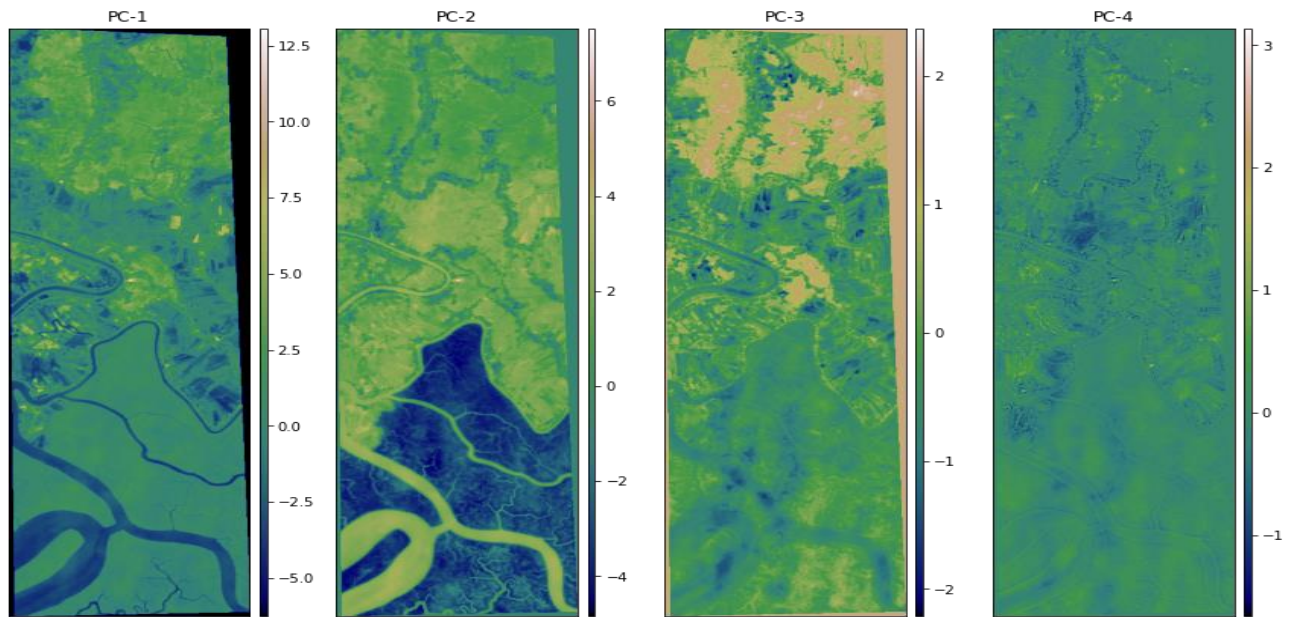


Fig 5.6 PCA image

Using the K-Means we can identify the cluster group and those are indicated in different colors.

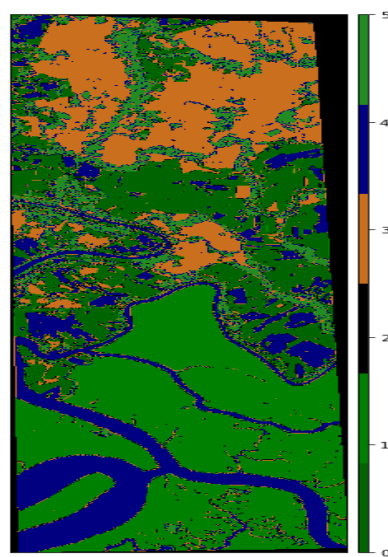


Fig 5.7 K-means output

Then this k-means image is passed to CNN algorithm. In CNN we follow the image classification based program to identify that given k-Means image is possible to face the flood or not. We train the image with flooded images and non flooded images and identify the accuracy of the training model.

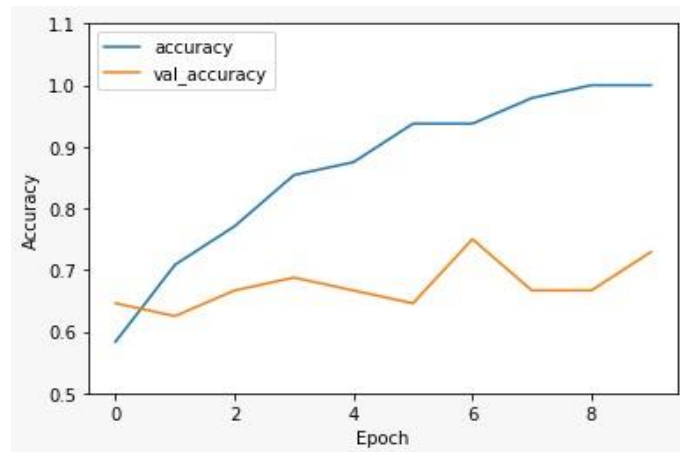


Fig 5.8 Accuracy of the k-means

At last it will display the output as “Possible” if flood occur is possible or “Not Possible” if flood occur is not possible. At last the final image is displayed.

```

river
[54]: x = CATEGORIES[prediction.argmax()]

if(x=="land"):
    print("Less Possible")
else:
    print(" Possible ")

Possible

```

Fig 5.9 Decision result

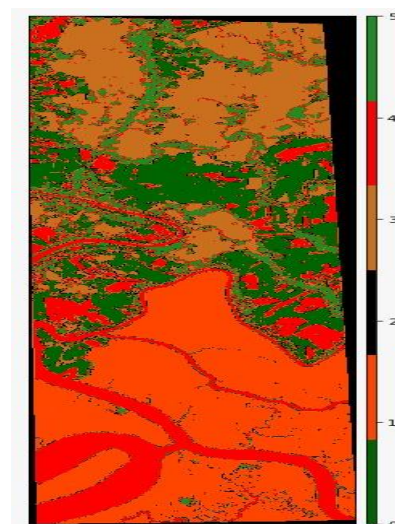


Fig 5.10 Output result

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 CONCLUSION

This project is useful to understand the features of the land and it provides data to people who don't have prior knowledge about the land that they going to construct their dream house or safe to live in that area. This project will be helpful to those people who need to know more information about the particular area. With this information, they can decide whether that particular area is safe from floods or not. This project has a feature to decide that particular area is safe to live in from flood or not.

6.2 FUTURE WORK

The aim disadvantage or drawback of this project is the input for this project. Since the input should be downloaded from the satellite images and the format should be in the .tif or .tiff format. It might be more difficult for the user to capture the satellite image in a particular format as well as the satellite images should have a different band set from band 1 to 12. This is the only thing that needs to be improved. The future work for this project aims to get the latitude and longitude data as an input in-order download the satellite image of the particular area with the same dimension as well as with the same band images.

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APPENDICES

SAMPLE CODE:

```
from glob import glob
import earthpy as et
import earthpy.spatial as es
import earthpy.plot as ep
import rasterio as rio
from rasterio.plot import plotting_extent
from rasterio.plot import show
from rasterio.plot import reshape_as_raster, reshape_as_image
import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap
import plotly.graph_objects as go
import geopandas as gpd
import os
import cv2
import random
import pickle
import keras
import time
from PIL import Image
import PIL
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D, Dense, Flatten
np.seterr(divide='ignore', invalid='ignore')
S_sentinel_bands=glob(r"C:\Users\Khaleel\Downloads\Satellite_Imagery_Analysis
-main\*B?*.tiff")
S_sentinel_bands.sort()
S_sentinel_bands
l = []
for i in S_sentinel_bands:
```

```

with rio.open(i, 'r') as f:
    l.append(f.read(1))
arr_st = np.stack(l)
arr_st.shape
ep.plot_bands(arr_st, cmap = 'gist_earth', figsize = (20, 12), cols = 6, cbar = False)
plt.show()
rgb = ep.plot_rgb(arr_st, rgb=(3,2,1), figsize=(10, 16), )
plt.show()
ep.plot_rgb(arr_st, rgb=(3, 2, 1), stretch=True, str_clip=0.2, figsize=(10, 16), )
plt.show()
colors = ['tomato', 'navy', 'MediumSpringGreen', 'lightblue', 'orange', 'blue',
          'maroon', 'purple', 'yellow', 'olive', 'brown', 'cyan']
ep.hist(arr_st, colors = colors, title=[f'Band-{i}' for i in range(1, 13)], cols=3,
alpha=0.5, figsize = (12, 10))
plt.show()
ndvi = es.normalized_diff(arr_st[7], arr_st[3])
ep.plot_bands(ndvi, cmap="RdYlGn", cols=1, vmin=-1, vmax=1, figsize=(10, 14))
plt.show()
vari = (arr_st[2] - arr_st[3]) / (arr_st[2] + arr_st[3] - arr_st[1])
ep.plot_bands(vari, cmap="RdYlGn", cols=1, vmin=-1, vmax=1, figsize=(10, 14))
plt.show()
ndmi = es.normalized_diff(arr_st[7], arr_st[10])
ep.plot_bands(ndmi, cmap="RdYlGn", cols=1, vmin=-1, vmax=1, figsize=(10, 14))
plt.show()
x = np.moveaxis(arr_st, 0, -1)
x.shape
x.reshape(-1, 12).shape, 954*298
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
X_data = x.reshape(-1, 12)
scaler = StandardScaler().fit(X_data)
X_scaled = scaler.transform(X_data)
X_scaled.shape
pca = PCA(n_components = 4)

```

```

pca.fit(X_scaled)
data = pca.transform(X_scaled)
data.shape
pca.explained_variance_ratio_
np.sum(pca.explained_variance_ratio_)
ep.plot_bands(np.moveaxis(data.reshape((954, 298, data.shape[1])), -1, 0),
              cmap = 'gist_earth',
              cols = 4,
              title = [f'PC-{i}' for i in range(1,5)])
plt.show()
from sklearn.cluster import KMeans
kmeans = KMeans(n_clusters = 6, random_state = 11)
kmeans.fit(data)
labels = kmeans.predict(data)
np.unique(labels)
ep.plot_bands(labels.reshape(954, 298), cmap=ListedColormap(['darkgreen',
'green', 'black', '#CA6F1E', 'navy', 'forestgreen']))
plt.show()
DIRECTORY=r'C:\Users\Khaleel\Downloads\CNN images-20210228T062714Z-
001\CNN images'
CATEGORIES = ['land', 'river']
data = []
for category in CATEGORIES:
    path = os.path.join(DIRECTORY, category)
    for img in os.listdir(path):
        img_path = os.path.join(path, img)
        label = CATEGORIES.index(category)
        arr = cv2.imread(img_path, cv2.IMREAD_GRAYSCALE)
        new_arr = cv2.resize(arr, (60, 60))
        data.append([new_arr, label])
Data
data[0][1]

```

```

random.shuffle(data)
X = []
y = []
for features, label in data:
    X.append(features)
    y.append(label)
X = np.array(X)
y = np.array(y)
X
Y
pickle.dump(X, open('X.pkl', 'wb'))
pickle.dump(y, open('y.pkl', 'wb'))
X = pickle.load(open('X.pkl', 'rb'))
y = pickle.load(open('y.pkl', 'rb'))
X
Y
X = X/255
X
X = X.reshape(-1, 60, 60, 1)
model = Sequential()
model.add(Conv2D(64, (3,3), activation = 'relu'))
model.add(MaxPooling2D((2,2)))
model.add(Conv2D(64, (3,3), activation = 'relu'))
model.add(MaxPooling2D((2,2)))
model.add(Flatten())
model.add(Dense(128, input_shape = X.shape[1:], activation = 'relu'))
model.add(Dense(2, activation = 'softmax'))
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
history = model.fit(X, y, epochs=5, validation_split=0.5)
X.shape
time.time()
type(1581428129.5990093)

```

```

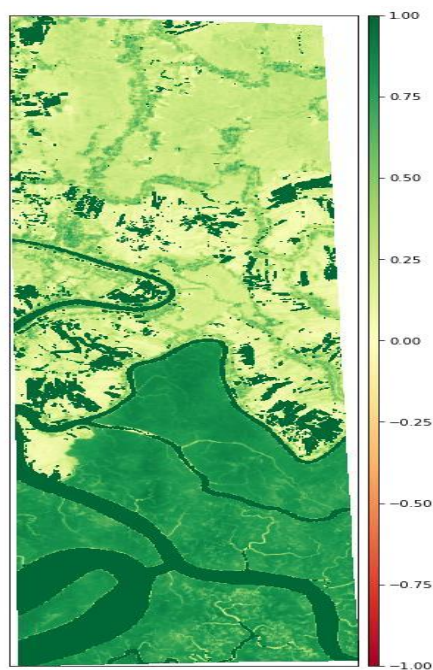
plt.plot(history.history['accuracy'], label='accuracy')
plt.plot(history.history['val_accuracy'], label='val_accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.ylim([0.001, 3])
plt.legend(loc='upper right')
test_loss, test_acc = model.evaluate(X, y, verbose=1)
CATEGORIES = ['river', 'land']
def image(path):
    img = cv2.imread(path, cv2.IMREAD_GRAYSCALE)
    new_arr = cv2.resize(img, (60, 60))
    new_arr = np.array(new_arr)
    new_arr = new_arr.reshape(-1, 60, 60, 1)
    return new_arr
model = keras.models.load_model('3x3x64-flood.model')
prediction = model.predict([image(r"C:\Users\Khaleel\Documents\New folder
(2)\Output.png")])
print(CATEGORIES[prediction.argmax()])
x = CATEGORIES[prediction.argmax()]
if(x=="land"):
    print("Less Possible")
else:
    print(" Possible ")

```

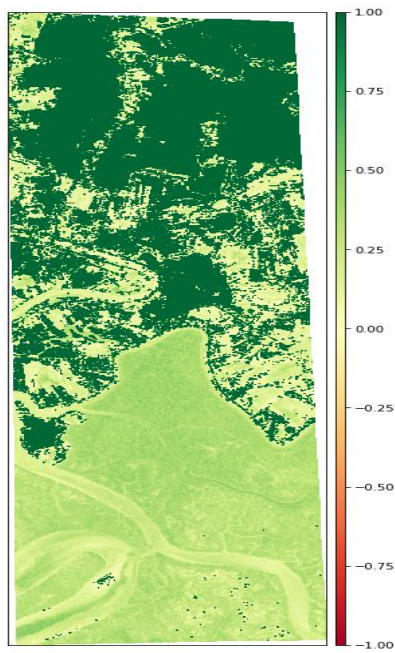
SCREEN SHOTS



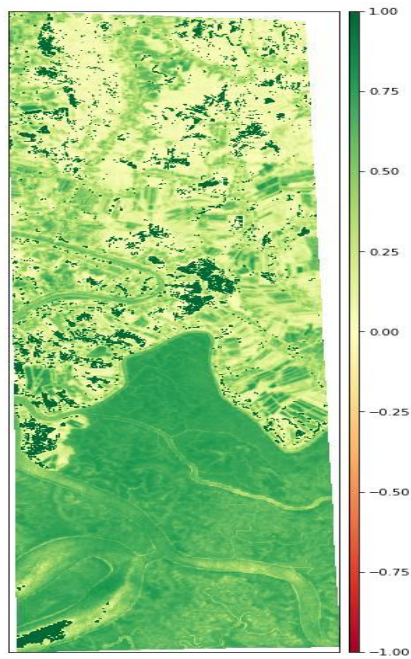
- RGB Image (Jamuna river, Bangladesh)



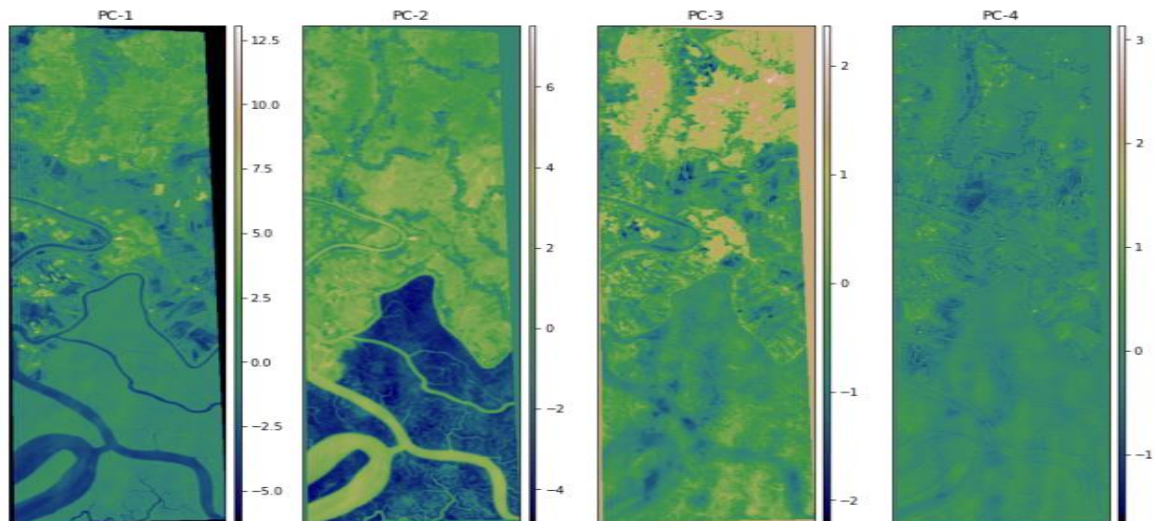
- NDVI(Normalized Difference Vegetation Index) image (band 8 and band 4) to identify the vegetation area from that we can identify land cover area as well water coverage areas



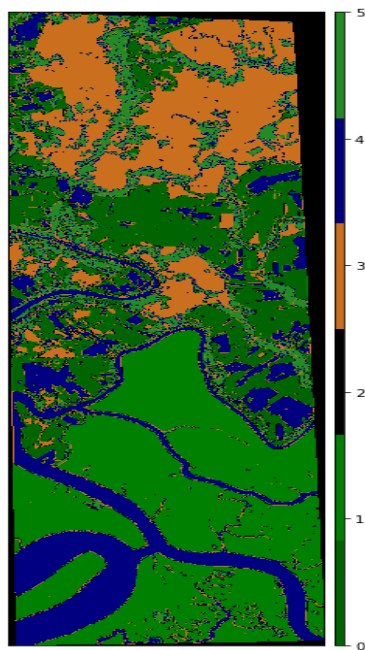
- We obtain VARI(Visible Atmospherically Resistant Index) image(band 2 , band 3 , band 4) to identify the high-level area



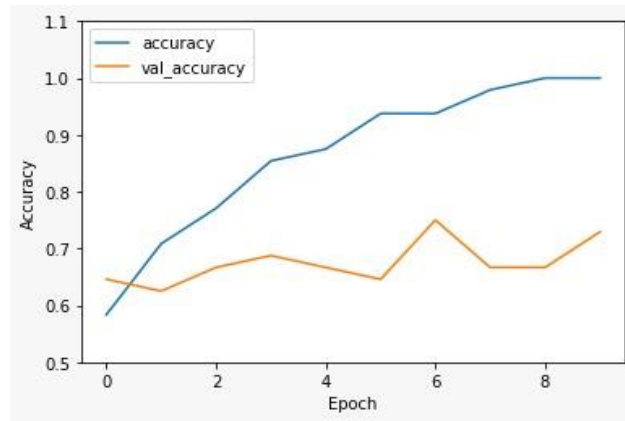
- We obtain NDMI(Normalized Difference Moisture Index)with band images(band 8 and band 11) to identify the water resource area in more details



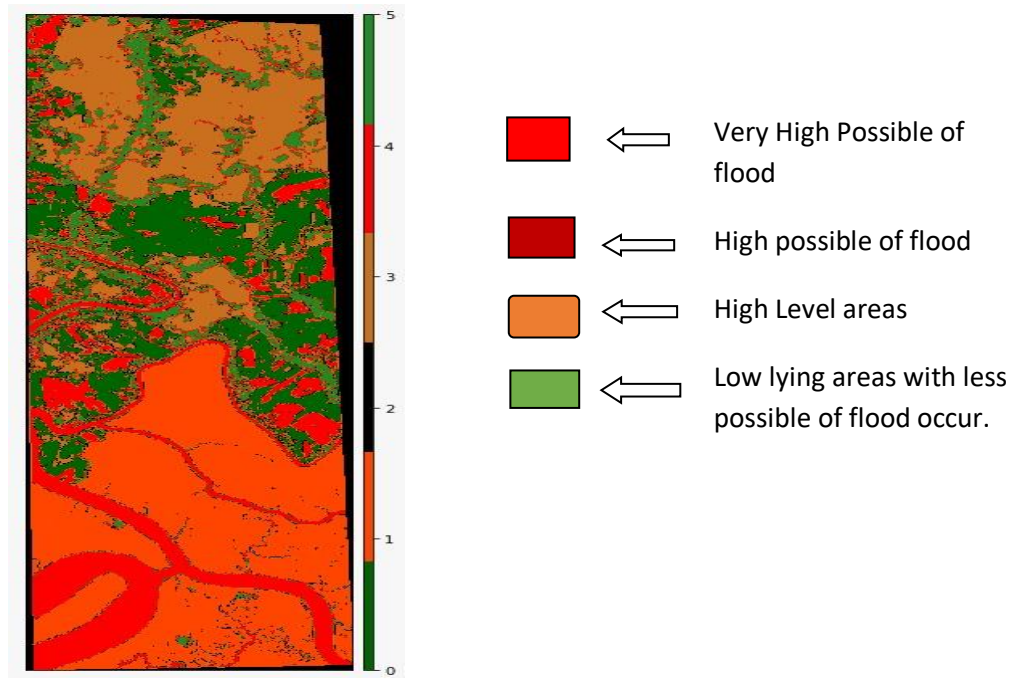
- By using the source image we obtain PCA images



- From PCA we obtain k-means value and the cluster values are displayed using visualized cluster



- Allowing the the visualized cluster to CNN to predict the accuracy



- CNN image result

PUBLICATION :

IDENTIFYING THE FLOODED AREA USING DEEP LEARNING

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Abstract-- In recent years many countries were still affected by the flood every year. People who live in low-level areas and people who are living near the water resource area such as lakes, dams, river, and other water reservoirs these areas were most affected by the flood every year. It is due to improper planning in constructing a building as well as other public constructions(i.e proper sewage system or drainage system). There are many reasons how floods occur but these two reasons are the most important reason because floods are occurred due to heavy rain but in today's situation even moderate rainfall cause flood due to there is no space for the rainwater to drain or reach the coastal area. This project aims to identify these areas which may face damages due to flood. And it provides information as well as decides whether the particular area is safe from damages due to flood.

Keywords-- Flood, Analysis of flooded areas, Flood forecasting, Flood hazard, Deep Learning.

I. INTRODUCTION

In today's world almost every country where facing various types of natural disasters such as Landslide, Earthquakes, Hurricanes, Tsunamis, Lightning, Tornadoes, Volcanic eruption, etc these are some natural disaster which causes huge damages to people all over the world. One of the

most dangerous disasters that most of the world faces is the river flood. Every year almost in every country millions of communities were faced massive damages due to floods. Regions like India, Bangladesh, China, Thailand, Indonesia, Iraq are some of the regions or countries that are mostly affected by the river flood. A flood is defined as an overflow of rain on the dry or un-moistured ground that engulfs the ground that usually dry. Flood is caused by massive rainfall in the grounds of the rivers and the poorly drained areas. When the surface of the water level increases beyond the surface of the rivers or dams the water started to overflow to areas adjoining the rivers, dams or lakes causes a flood.

Flood is differentiated into four types they are Flash flood, Coastal flood, Urban flood, River flood, and Ponding these are the five major types of flood. Flash floods are the rapid flood of low-level areas. It causes due to massive rain correlated with a hard storm, typhoon, cyclone, or melting of water from ice or snow moving over glaciers or icebergs. Coastal floods are one of the types of flooding it normally occurs in the coastal areas as the sea level rises, at the time of heavy rain it causes the flood. Urban flood is a type of flood that happens in urban areas. It happens when a river overwhelms its surface banks or when a hurricane hits a storm floods across the seacoast caused by extreme flow in developing states if rainwater does not have anyplace to move.

River floods are caused when there a sudden rise in water level in river or dam or lake and other water resources during heavy rain. Ponding implies a type of flood occurs in low-

lying regions where the rainwater continues to fall in an area where normally store the water in the ground or channels, or ponds are removed away or elevated out when more extra rainfall enters into the water-management system. When it approaches the highest level at that event the flood occurs. Flood mainly cause great damage to people who live in the lower level such as the areas which is near to the river flowing area or place where lakes are situated or near the dam. These areas were facing high damages during the time of the flood. In some surveys say that changing the land level or covering the river path or lake which are dry for many years for constructing industries or apartments these might affect the people who live in that area in the time of the flood. These are some reasons when a flood occurs in developed as well as in developing countries. Flood occurring areas are cannot be analyzed since every year

II. LITERATURE REVIEW

Sohaa A. Mohaamed refers to the current direction of the water flow and water lying area are obtained from ATER and Radiometer with an absolute resolution. To describe these hydrological and the ATER and DEMs are used as data in ArGIS. Image processing combines seven bands from band 1 to band 7 together in a form of a single image Land area cover is considered complex to understand. Land area cover refers to urban, agriculture, and stony area, etc. Supervised learning uses image classification to derive the available land areas.[2]Wei-hsi hung refers that the LSTM model forgets the worthless information into the ignore gate also studies valuable data from traditional data. The CNN model can obtain designs from social courses and pass the same models happening in various sections. The LSTM model uses long-term dependencies to explain the approximate rainwater level forecasts. The LSTM performed well in predicting the water level For further improvements in the accuracy and stability of water level prediction.[3]Rahat Iqbal refers that the flooding that may occur over rainfalls. The precipitation increases far and is added quickly at raised temperatures. Higher temperature impacts create the cloud and form rainfall. Humidity exists in the quantity of fog in the atmosphere that is when compared to what the air can hold at an environmental temperature. Soil conversion is the method by which rainwater on the exterior penetrates the soil and the soil becomes the ability to consume rainfall.[4]Amir Mosavi refers that the ANNS method is most popularly used in ML due to its high approximate value as well as the high power processing with complex flood functional process. where the data-sets are improper or incomplete. But generalization remains as same as an issue in working with ANNS.[5]Atieh Alipour refers that the flood damages were classified into two parts they are training and testing. As the outcome of the model is examined by the two execution such as correlation coefficient and bias which must be generally used to estimate the efficiency and execution of the flood prediction.

III. METHODOLOGIES AND APPROACHES

For this project to identify the flooded area we use the USGS satellite image in .tiff format of same dimension. The .tiff satellite images is used to identify the detailed information about the particular environment. Since the aim of the project is to identify the low lying areas, high level area and water reservoirs which are situated in that particular region. Since most river floods are occurs in that particular region and causing more damages and affecting the people who lives in that region. Here in this project we use some of the python packages like Rasterio, Geopandas, Matplotlib, Pandas these are some packages which plays a major role in reading and gather the information from the satellite image using different band images (band1 to band12). Rasterio is a special python package especially used for raster the satellite images and also used for reading and writing the geospatial raster formats in python. Since the rasterio is based on the GDAL it extract the details which are present in the satellite image by using the band images. And another important python packages in this python is that geopandas is used to work with geospatial data and work with rasterio process.

After importing the python packages for identifying whether the satellite image consist the water cover areas along with land cover. To identify it we use the NDVI to differentiate the land cover as well ware cover areas. Since the NDVI is use the normalization difference using band8 and band 4 to identify the vegetation area from that we can identify land cover area as well water coverage areas.

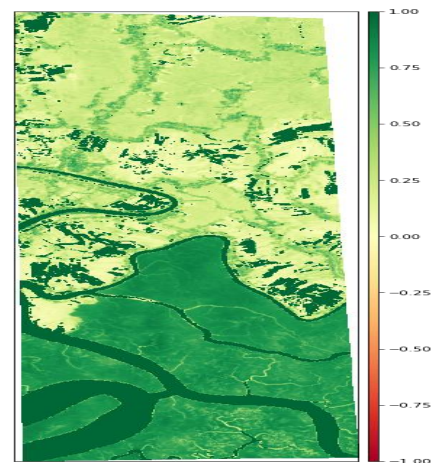


Figure 3.1

But from this NDVI we can't identify or differentiate the High-level area as well as low lying area or

the river path from the NDVI. To identify the high-level area we use the VARI formula for this model since VARI is meant to indicate crops in the obvious portion of the color while decreasing flash differences and meteorological effects. By using the atmospheric effect we can observe as well as differentiate the levels of the land cover(i.e. low lying area as well as high-level areas). VARI uses the band3, band4 and band2 by an equation format $((\text{band3} - \text{band4})/(\text{band3} + \text{band4} - \text{band2}))$.

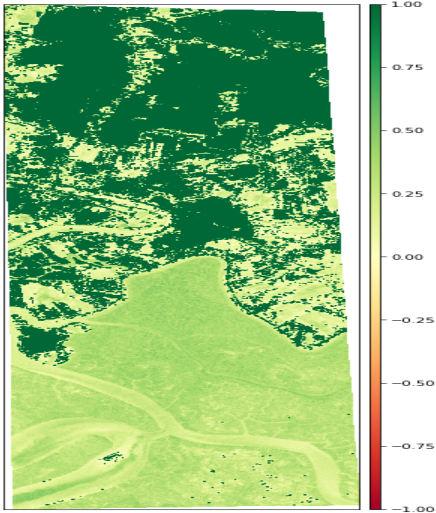


Figure 3.2

Now To identify the water resource area in more details we use the NDMI because the NDMI is normally used to identify the crop water stress level. By using the NDMI we can easily identify the moisture area like dams, river, sea, and other water reservoirs. This NDMI(Normalized Difference Moisture Index) can easily predicts the Moisture areas by using the normalization difference by using band8 and band11 . After applying the NDMI we implemented the PCA Algorithm.

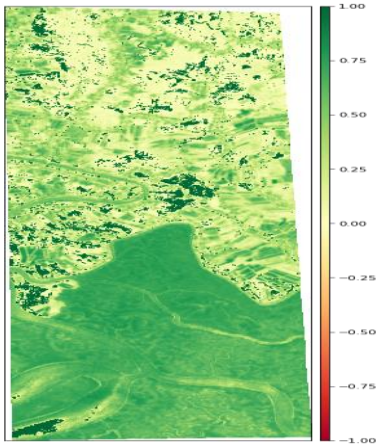


Figure 3.3

The PCA Algorithm is used high compression details since the PCA is used to mathematical techniques to overcome the dimensions of the data- set. After processing the PCA now the band is visualized with detailed images of the low-lying land, the high-level areas, and the water resource areas. After implementing the PCA there some detailed views appear in the result of the PCA. After that, we implemented the K-means algorithm for this project to identify the cluster values from the output of the VARI. After identifying the cluster value these cluster values are visualized using the Visual cluster. From the visual cluster, we can compare the difference between the RGB image and the cluster images.

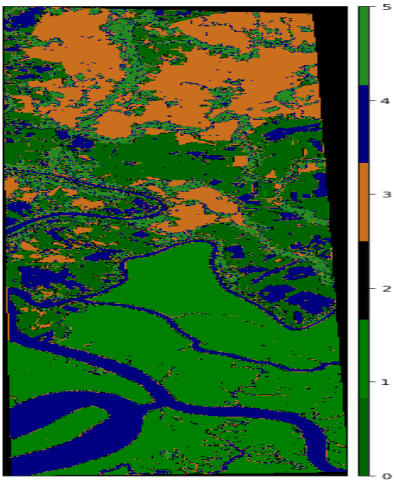


Figure 3.4

The result of the visualized output is then applied to the CNN(Convolution Neural Network). These CNN(Convolution Neural Network) is trained with the multiples images of the land cover areas as well as the images of the water resource areas in-order to make a decision whether that particular region will face sever damages due to flood or not.

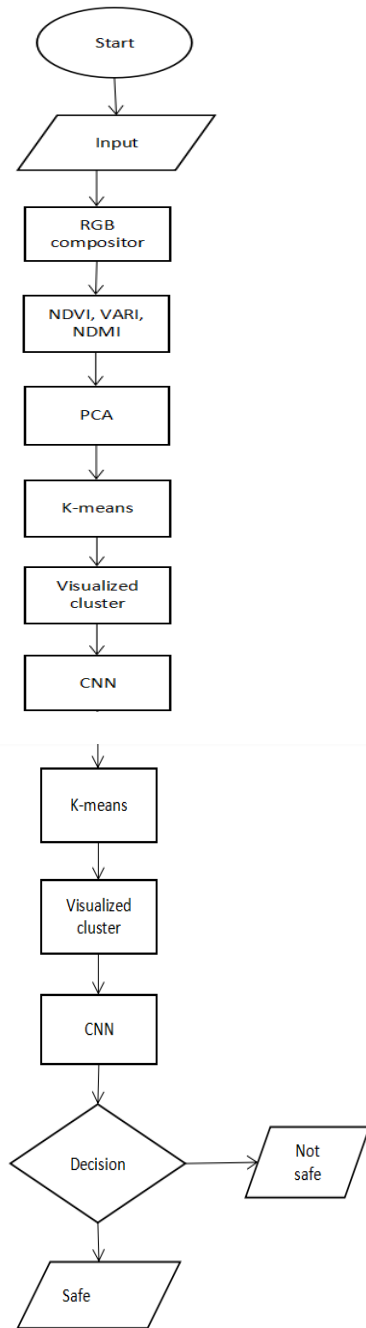


Figure 3.5

IV. RESEARCH AND RESULT

This project aims to identify the particular region is might face damages due to the flood. This project searches for some basic information from the particular region. Since most of the flood regions are happens in the areas like low-level areas, riverside or water resource areas like dams, lakes, dry lakes, etc. Such these areas are frequently facing damages due to floods. This area might also face some damages during a heavy or moderate rainfall. By gathering these information this project aims at three simple pieces of information. Identify the low-level area, Identify the high-level area, Identify the water resources, and the result is trained with CNN algorithm which the result is matched with CNN trained models (i.e. river area and land area) and the final decision is given as output.

S.NO	Surface	Accuracy
1	Land	85%
2	River	90%

Table 5.1

From the accuracy table we can analyse that the project analyse the land surface and the water resources area since the land was found near the river or other water reservoirs which are dry and shown the river path which has been flown over an year. This simple information will help the people without affecting by the flood. This project will work only with satellite images of the different band set from band 1 to band 12 with the same dimension with the same image

V. CONCLUSION

Almost 80 to 90 percentage of the people don't have prior knowledge about the appropriate area whether the area was overwhelmed by the flood or whether the area was at a low level of any water resources are found near the particular area. These are basic information people will not mind before they going to live in that particular area or buy that particular land to construct their dream house. This project is useful to understand the features of the land and it provides data to people who don't have prior knowledge about the land that they going to construct their dream house or safe to live in that area. This project will be helpful to those people who need to know more information about the particular area. With this information, they can decide whether that particular area is safe from floods or not. This project has a feature to

decide the appropriate area is safe to survive from flood or not.

VI. REFERENCES

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PLAGIARISM :

The screenshot shows a PDF viewer window with the file 'mdaymanl@hotmail.com.pdf' open. The document content is an 'ORIGINALITY REPORT' for the same file. The report displays the following similarity percentages:

Category	Percentage
SIMILARITY INDEX	16%
INTERNET SOURCES	14%
PUBLICATIONS	14%
STUDENT PAPERS	11%

Below the percentages, the 'PRIMARY SOURCES' are listed:

Rank	Source	Percentage
1	dblp.dagstuhl.de Internet Source	4%
2	Submitted to Indian Institute of Technology, Madras Student Paper	4%
3	onlinelibrary.wiley.com Internet Source	1%

The Windows taskbar at the bottom shows the time as 3:45 PM on 4/5/2021.