

NATURAL DISASTER INTENSITY ANALYSIS AND CLASSIFICATION USING ARTIFICIAL INTELLIGENCE

A PROJECT REPORT

SUBMITTED BY

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In partial fulfilment for the award of

BACHELOR OF TECHNOLOGY

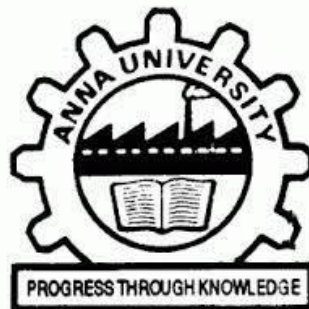


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1.

INTRODUCTION

1.1 PROJECT OVERVIEW

Natural disasters are large-scale geological or meteorological events that have the potential to cause loss of life or property. A disaster is a result of a natural or man-made hazard impacting a vulnerable community. It is the combination of the hazard along with exposure of a vulnerable society that results in a disaster. The project aims at building a deep learning model that can classify and tell the intensity of a natural disaster based on images. The project uses a multilayered deep convolutional neural network as the main model architecture and also it uses various techniques to enhance the model performance and robustness such as data augmentation, transfer learning, and ensemble methods. The project can have various applications and use cases for disaster management and response such as providing timely and accurate information, assessing the damage and impact, and facilitating the recovery and reconstruction.

1.2 PURPOSE

The purpose of natural disaster intensity analysis and classification using AI is to build a deep learning model that can classify and tell the intensity of a natural disaster based on images. This can help to overcome losses in ecosystems, human lives, and properties by providing timely and accurate information for disaster management and response. It can also be integrated with other technologies such as geographic information systems, remote

sensing, and social media to provide a comprehensive and multidimensional view of the disaster situation and impact.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEMS

There is no standardized method for estimating tropical cyclone intensity. The low-pressure system developing over Bay of Bengal and South East Asian region makes a landfall and often these cyclone causes life loss, property loss. Due to flood many life losses occurs because of not giving any forecast or intimation about flood.

2.2 REFERENCES

TITLE: Tropical Cyclone Intensity Estimation Using Multidimensional Convolutional Neural Network from Multichannel Satellite Imaginary

AUTHOR: Wei Tian, Xinxin Zhou, Wei Huang, Yonghong Zhang, Pengfei Zhang, Shaofeng Hao

ABSTRACT:

Estimating tropical cyclone (TC) intensity is the first step in the processes of monitoring and predicting destructive TC disasters. Due to the dilemma of meteorological methods, accurate estimation of TC intensity is a Longterm challenge. In recent years, while deep learning methods have been applied to TC intensity estimation, most of them fail to make full use of multichannel satellite imageries to consider the three-dimensional (3-D) structure of TC. In this letter, we propose a novel deep learning model (3DAttentionTCNet) to overcome this shortcoming. The model can automatically extract 3-D environment information related to TC intensity from multichannel satellite observation imageries such as infrared (IR), water vapor (WV), and passive microwave rain rate (PMW) satellite imageries by 3-D convolution. In addition, we employ the convolutional block attention module (CBAM) to simulate visual attention for strengthening the model's attention to core cloud structure and important channels. The experimental results show that the root-mean-square error (RMSE) of the proposed model is 9.48 kts, which is improved by 25% compared to that of the advanced

Dvorak technique (ADT) and by 9.2% over that of the traditional deep learning method of TC intensity estimation.

TITLE: Vulnerability analysis of cyclone hazards and Dimension of disaster risk management in Odisha Along the east coast of India

AUTHOR: Jitendra Kumar Behera and Gopal Krishna Panda Dept. of Geography, Utkal University Vani Vihar, Bhubaneswar – 751004 Odisha India

ABSTRACT:

Odisha is one of the most vulnerable states for the hazards of the tropical cyclones along the east coast of India since time immemorial. The low-pressure systems developing over the Bay of Bengal and South East Asian region makes a landfall along the Odisha coast and travel inland. Very often these cyclonic hazards had turned in to disasters affecting the life, livelihood and property of the people. Strong wind, torrential rain, flooding and unusual storm surges accompanied with the cyclones cause severe devastations with the destruction of dwellings, damage to infrastructure and standing crops besides loss of life along the track of its movement and adjacent areas. Odisha's exposure to these extreme events, people's perception and human response, adaptations, its risk mitigation and management has undergone a sea change in the twenty-first century keeping at pace with the scientific innovations and international guidelines. This study makes an attempt to assess the vulnerability of the state to the tropical cyclones based on a Disaster Risk Index. Time series and spatial analysis is used to study their trend and impacts. Content analysis is used to study the innovative strategies of disaster risk reduction of achieving the zero casualty as per the Sendai framework and community resilience. The findings of the study indicate an increasing vulnerability of the state to a greater number of severe cyclones. But however, the revised strategies in crisis management and community-based disaster preparedness have been the key to the success in reducing disaster risk in the state.

TITLE: Designing Deep-Based Learning Flood Forecast Model with ConvNet Hybrid Algorithm

AUTHOR: Mohammed Meishin School of Science, University of Southern
Queensland Springfield, Springfield, QLD, Australia

ABSTRACT:

Efficient, robust, and accurate early flood warning is a pivotal decision support tool that can help save lives and protect the infrastructure in natural disasters. This research builds a hybrid deep learning (Comvest) algorithm integrating the predictive merits of Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM) Network to design and evaluate a flood forecasting model to forecast the future occurrence of flood events. Derived from precipitation dataset, the work adopts a Flood Index (IF), in form of a mathematical representation, to capture the gradual depletion of water resources over time, employed in a flood monitoring system to determine the duration, severity, and intensity of any flood situation. The newly designed predictive model utilizes statistically significant lagged IF, improved by antecedent and real-time rainfall data to forecast the next daily IF value. The performance of the proposed ConvLSTM model is validated against 9 different rainfall datasets in flood prone regions in Fiji which faces flood-driven devastations almost annually. The results illustrate the superiority of ConvLSTM-based flood model over the benchmark methods, all of which were tested at the 1-day, 3-day, 7-day, and the 14-day forecast horizon. For instance, the Root Mean Squared Error (RMSE) for the study sites were 0.101, 0.150, 0.211 and 0.279 for the four forecasted periods, respectively, using ConvLSTM model. For the next best model, the RMSE values were 0.105, 0.154, 0.213 and 0.282 in that same order for the four forecast horizons. In terms of the difference in model performance for individual stations, the Legate-McCabe Efficiency Index (LME) were 0.939, 0.898, 0.832 and 0.726 for the four forecast horizons, respectively. The results demonstrated practical utility of ConvLSTM in accurately forecasting IF and its potential use in disaster management and risk mitigation in the current phase of extreme weather events.

2.3 PROBLEM STATEMENT DEFINITION

A problem statement is a concise description of an issue to be addressed or a condition to be improved upon. It identifies the gap between the current (problem) state and desired (goal) state of a process or product.



3. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

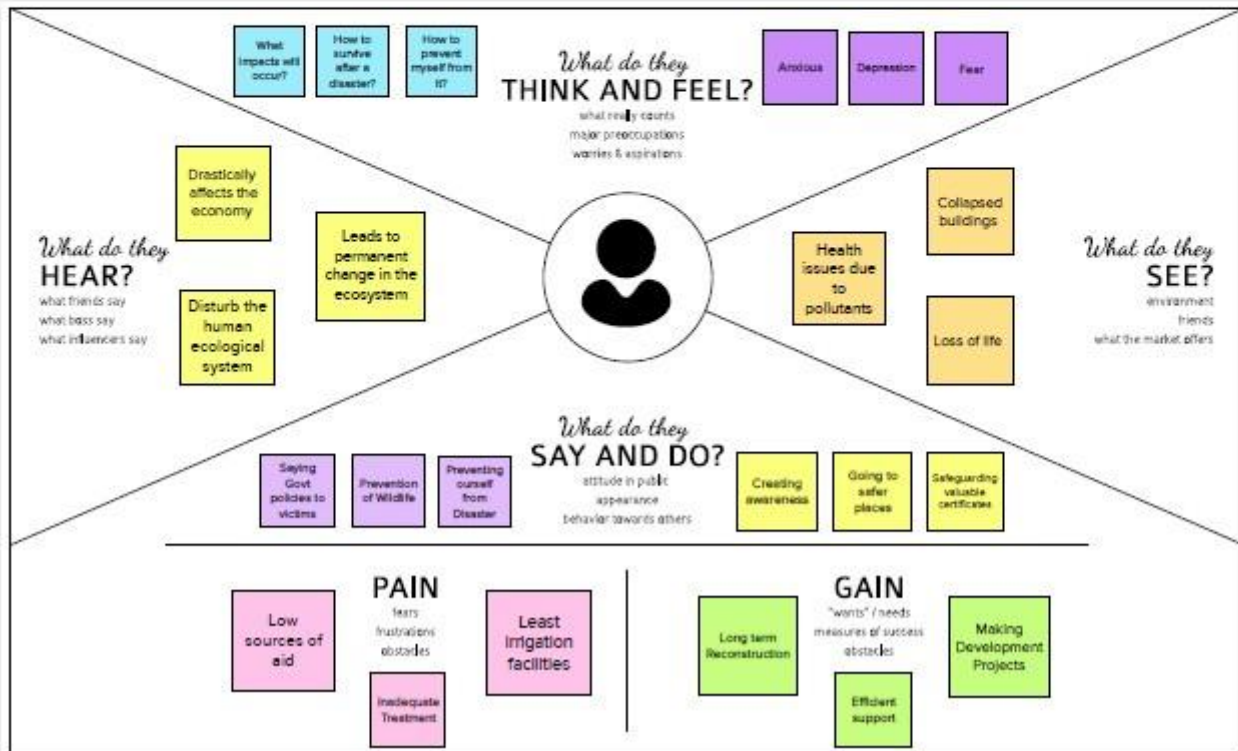
An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment.

Empathy Map Canvas

Gain insight and understanding on solving customer problems.

1

Build empathy and keep your focus on the user by putting yourself in their shoes.



Share your feedback

3.2 IDEATION AND BRAINSTORMING

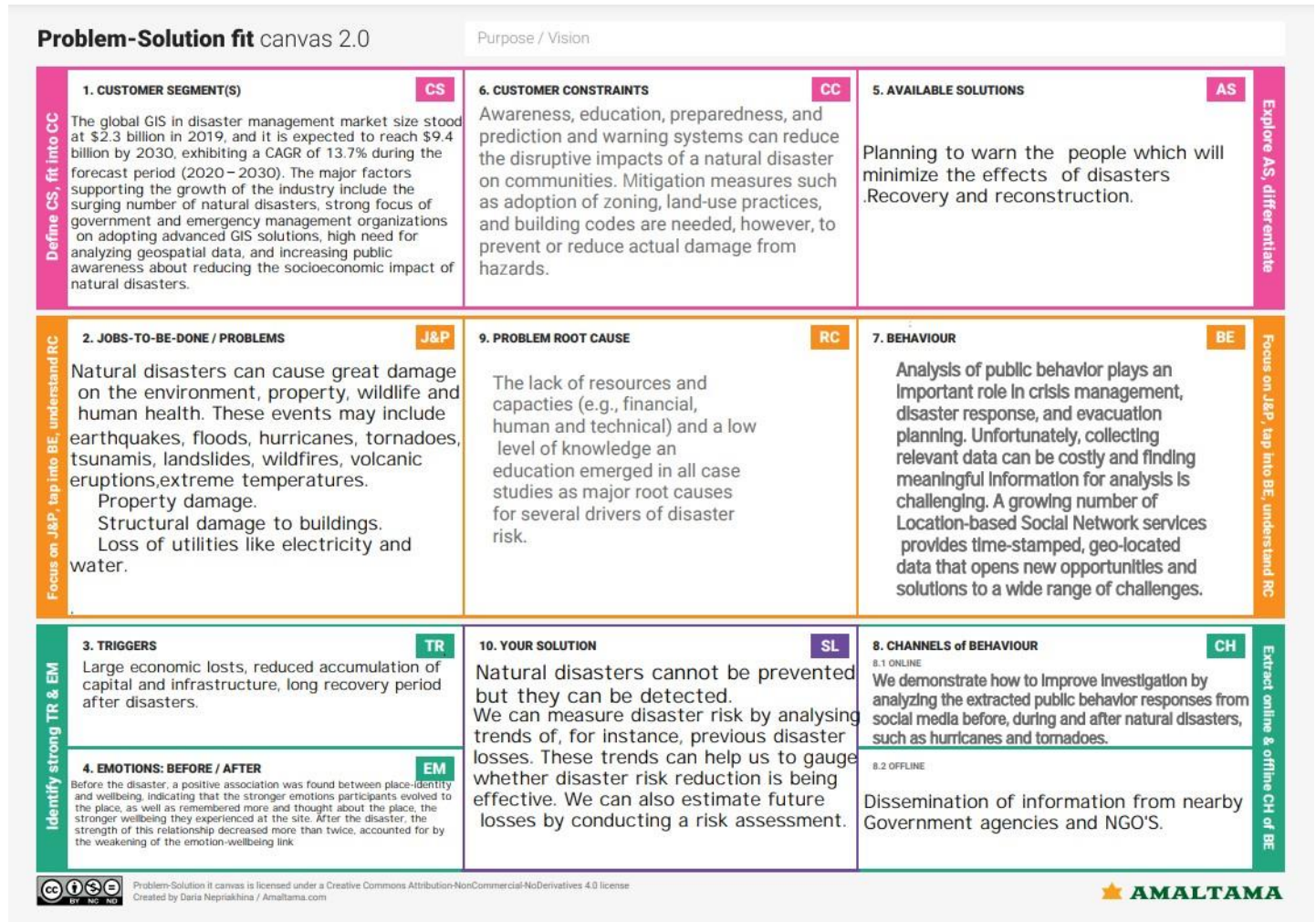
Brainstorming is a group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members.

3.3 PROPOSED SOLUTION

Proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved.

3.4 PROBLEM SOLUTION FIT

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

The following are the functional requirements of the proposed solution.

| FR No. | Functional Requirement (Epic) | Sub Requirement (Story / Sub-Task) |
|--------|-------------------------------|---|
| FR-1 | LOGIN | Login by giving a mobile number, gmail or google account and their location. |
| FR-2 | ALERT | The alert message is given to all the users when the cyclone hits. |
| FR-3 | MONITORING | Continuous monitoring of cyclones and climate changes. |
| FR-4 | REPORTS | Keeping the records of the previous cyclone and refer news from meteorologist for live updates. |
| FR-5 | END USERS | The information is sent to the farmers using the database. |
| FR-6 | END GOAL | Inform farmers about the cyclone and its intensity. |

4.2 NON-FUNCTIONAL REQUIREMENTS

The following are the non-functional requirements of the proposed solution :

| FR No. | Non-Functional Requirement | Description |
|--------|----------------------------|-------------|
|--------|----------------------------|-------------|

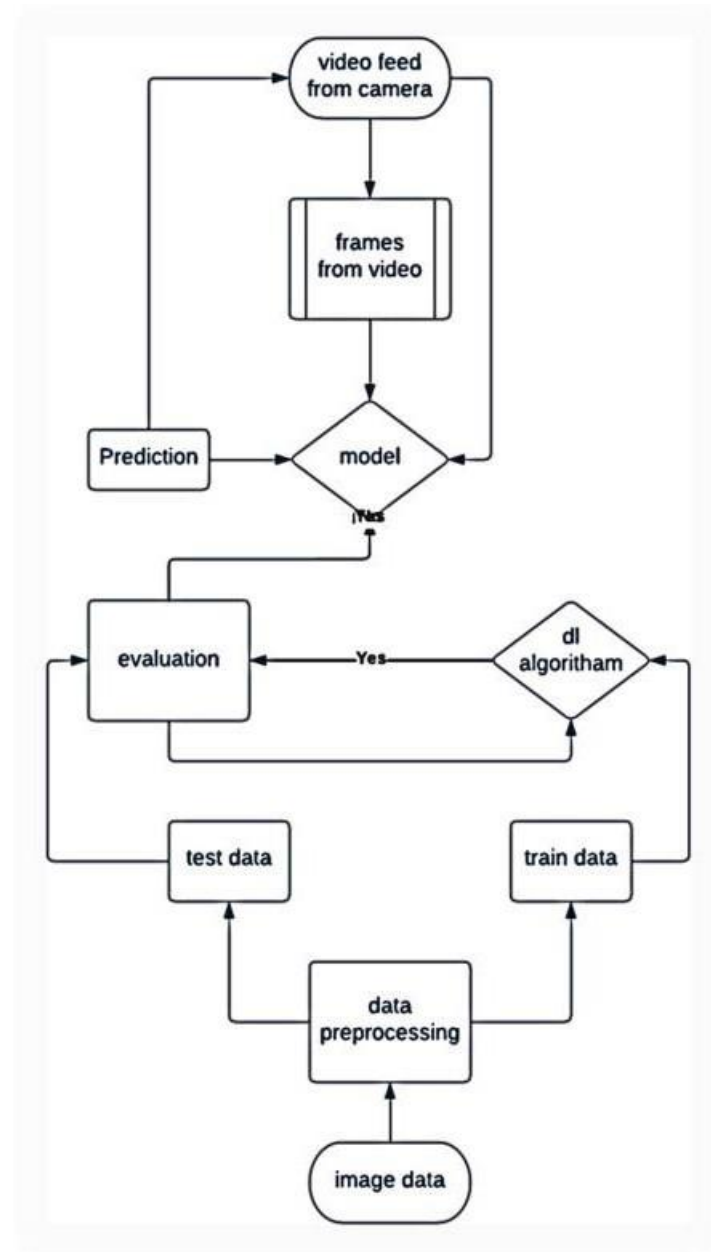
| | | |
|-------|--------------------|---|
| NFR-1 | USABILITY | While using this system, people turn on their current location. They receive alert messages as notification. The local officials can also inform and guide their nearby people and farmers by an alert message. |
| NFR-2 | SECURITY | It does not share any personal information to strangers. Their information is to be encrypted and |
| NFR-3 | RELIABILITY | As the details collected from satellite image and meteorologist and updated details in this system, so it is trustworthy. |
| NFR-4 | PERFORMANCE | It runs in minimum storage space. It will run efficiently when 1000 users login the same time. |

| | | |
|-------|---------------------|--|
| NFR-5 | AVAILABILITY | It should be available in all Android phones and laptops. |
| NFR-6 | SCALABILITY | As the product we created is user friendly and it will be very useful for farmers and agriculture. |

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

A data-flow diagram is a way of representing a flow of data through a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself.



5.2 USER STORIES

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer.

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task | Acceptance criteria | Priority | Release |
|------------------------|-------------------------------|-------------------|--|--|----------|-----------|
| Customer (Mobile user) | LOGIN | USN-1 | As a farmer, I can login by giving mobile number, gmail or google account and their location. | I can prepare myself from cyclone and storing enough food and essentials | High | Sprint- 1 |
| | ALERT | USN-2 | As a farmer, I can receive the alert message when the cyclone hits. | I can know about current climatic conditions and upcoming weather conditions | High | Sprint- 2 |
| | MONITORING | USN-3 | As a farmer, I can view the continuous monitoring of cyclone and climatic changes. | I can know where the cyclone hits and how much impacts it may create | High | Sprint- 3 |
| | REPORTS | USN-4 | As a farmer, I can keep the records of the previous cyclone and refer news from meteorologist for live updation. | I can receive the alert messages when the disaster occurs | High | Sprint- 4 |

| | | | | | | |
|--|------------------------|-------|--|---|------|-----------|
| | END USERS (farmers) | USN-5 | As a farmer, I can receive the information from the database. | I should ensure that any stored seeds or harvested crops are carefully protected from wind and flooding | High | Sprint- 5 |
|--|------------------------|-------|--|---|------|-----------|

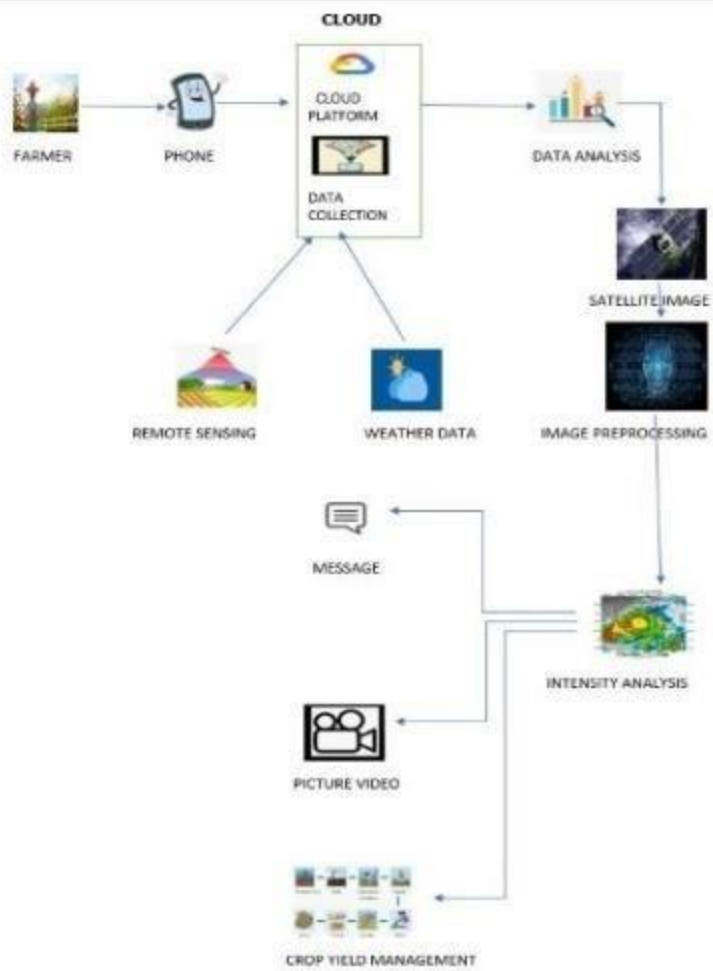
5.3 SOLUTION AND TECHNICAL ARCHITECTURE

SOLUTION ARCHITECTURE

A solution architecture (SA) is an architectural description of a specific solution. SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).

TECHNOLOGY STACK

A tech stack is the combination of technologies a company uses to build and run an application or project. Sometimes called a “solutions stack,” a tech stack typically consists of programming languages, frameworks, a database, front-end tools, back-end tools, and applications connected via APIs.



6. PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|----------|-------------------------------|-------------------|---|--------------|----------|-------------------|
| Sprint-1 | Registration | USN-1 | As a user, I can register for the application by entering my email, password, and confirming my password. | 2 | High | Syed Ashik Ahamed |
| Sprint-1 | | USN-2 | As a user, I will receive confirmation email once I have registered for the application | 1 | High | Hariharan |
| Sprint-2 | | USN-3 | As a user, I can register for the application through Facebook | 2 | Low | Navinkumar |
| Sprint-2 | | USN-4 | As a user, I can register for the application through Gmail | 2 | Medium | Vignesh |
| Sprint-1 | Login | USN-5 | As a user, I can log into the application by entering email & password | 1 | High | Syed Ashik Ahamed |
| Sprint-1 | Dashboard | USN-6 | As a user, I can access the services and information provided in the dashboard | 2 | High | Hariharan |
| Sprint-1 | login | USN-7 | As a user, I can log into the web application and access the dashboard | 2 | High | Navinkumar |
| Sprint-4 | Helpdesk | USN-8 | As a user, I can get the guidance from the customer care | 1 | High | Vignesh |

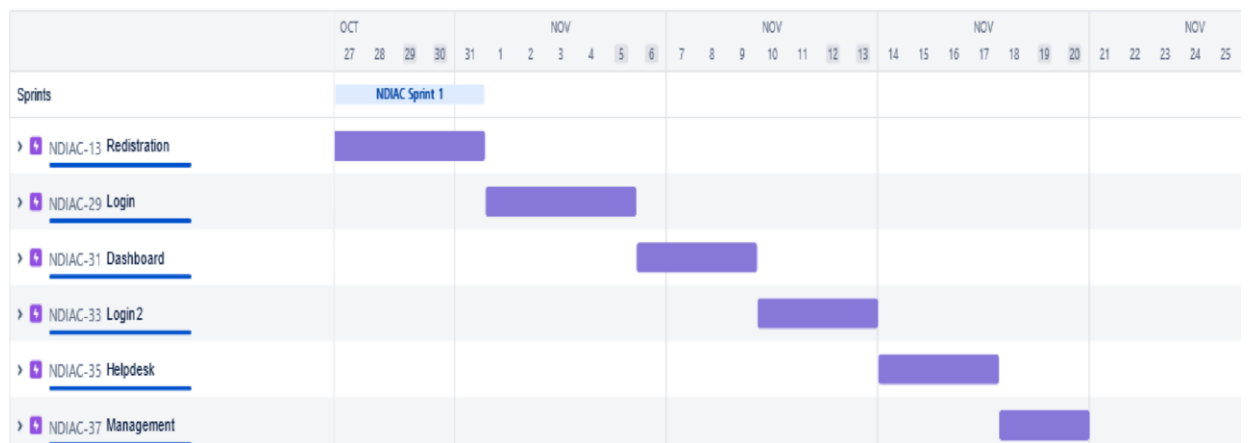
| | | | | | | |
|----------|------------|-------|--|---|------|-------------------|
| Sprint-3 | Management | USN-9 | As an administrator, I can collect new datasets and keep the model trained | 2 | High | Syed Ashik Ahamed |
|----------|------------|-------|--|---|------|-------------------|

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|----------|-------------------------------|-------------------|---|--------------|----------|--------------|
| Sprint-3 | | USN-10 | As an administrator, I can update other features of the application | 2 | Medium | Hariharan |
| Sprint-3 | | USN-11 | As an administrator, I can maintain the information about the user | 2 | Medium | Navinkumar |
| Sprint-4 | | USN-12 | As an administrator, I can maintain third-party services | 1 | Low | Vignesh |

6.2 SPRINT DELIVERY SCHEDULE

| Sprint | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on planned End Date) |
|----------|--------------------|----------|-------------------|---------------------------|---|
| Sprint 1 | 8 | 6 Days | 26 Oct 2022 | 31 Oct 2022 | 8 |
| Sprint 2 | 4 | 6 Days | 01 Nov 2022 | 06 Nov 2022 | 4 |
| Sprint 3 | 6 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | 6 |
| Sprint 4 | 2 | 6 Days | 13 Nov 2022 | 18 Nov 2022 | 2 |

6.3 REPORTS FROM JIRA



7. CODING AND SOLUTIONING

7.1 FEATURE 1:

HTML

Home page:

```
<!DOCTYPE html>

<html>

    <head>
        <title>Home page</title>
    </head>
    <body>

        <a href = "Intro page.html">Intro page </a>
        <a href = "Upload page.html">Upload page </a>

        <h1>AI BASED NATURAL DISASTER ANALYSIS</h1>
        <img src = "D:\Disasters\CYCLONE.jpg">
        <img src = "D:\Disasters\EARTHQUAKE.jpg">
        <img src = "D:\Disasters\FLOOD.jpg">
        <img src = "D:\Disasters\FOREST FIRE.jpg">
        </body>

</html>
```

Intro page:

```
<!DOCTYPE html>

<html>

    <head>
        <title>Intro page</title>
    </head>
    <body>

        <a href = "Home page.html">Home page </a>
        <a href = "Upload page.html">Upload page </a>

        <h1>AI BASED NATURAL DISASTER ANALYSIS</h1>
        <p>A Disaster is a serious problem occurring over a short or long period of time that causes widespread human, material, economic or environm
        </body>

</html>
```

Upload page:

```

<!DOCTYPE html>

<html>

    <head>

        <title>Upload page</title>

    </head>

    <body>

        <a href = "Intro page.html">Intro page </a>
        <a href = "Home page.html">Home page </a>

        <h1>AI BASED NATURAL DISASTER ANALYSIS</h1>
        <img src = "D:\Emergency\Emergency alert.jpeg">

    </body>

</html>

```

7.2 FEATURE 2:

PYTHON

```
from flask import Flask, render_template,request import cv2
```

```
import TensorFlow from tensorflow.keras.models import
```

```
load model from werkzeug.u ls import secure filename app=
```

```
Flask (__name__, template folder="templates") model=load
```

```
model('disaster.h5') print ("Loaded model from disk")
```

```
@app.route('/', methods=['GET']) def index ():          return
```

```
render template('home.html') @app.route('/home',
```

```
methods=['GET'])
```

```
def home ():  return render template('home.html')
```

```
@app.route('/intro'. methods['GET']) def about ():  return
```

```
render_tempalte('intro.html') @app.route('/upload',
```

```
methods= ['GET', 'POST'])
```

```
def predict ():
```

```
cap= cv2.VideoCapture(0)
```

```
while True:
```

```

_, frame = cap.read()

frame = cv2.flip(frame,1)

while True:

    (Grabbed, frame) =vs. Read

    ()if not grabbed:

break

    if W is None or H is None:

(H, W) = frame. Shape[:2]

output = frame. Copy()

frame = cv2.cvtColor(frame, cv2.color_BGR2RGB)

frame = cv2.resize(frame, (64,64))

x= np.expand_dims(frame, axis=0)

result = np.argmax(model. Predict(x), axis=-1)

index = {'Cyclone','Earthquake','Flood','Wildfire'}

result = str(index[result [0]])

cv2.putText(output, "ac viny: {}", format(result),

(10,120),cv2.FONT_HERSHEY_PLAIN,1, (0,255,255), 1)

    cv2.imshow("Output", output)

key = cv2.waitKey(1) & 0xFF

if key == ord("q"):

    break

    print("[INFO] cleaning up...")

```

```

vs.release()

cv2.destroyAllWindows()

return

render_template("upload.html")

if __name__ == '__main__':

    app.run(host='0.0.0.0', port=8000, debug=False)

```

8. TESTING

8.1 TEST CASES

| Section | Total Cases | Not Tested | Fail | Pass |
|---------------------|-------------|------------|------|------|
| Client Application | 10 | 0 | 3 | 7 |
| Security | 2 | 0 | 1 | 1 |
| Performance | 3 | 0 | 1 | 2 |
| Exception Reporting | 2 | 0 | 0 | 2 |

8.2 USER ACCEPTANCE TESTING

DEFECT ANALYSIS

| Resolution | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Total |
|----------------|------------|------------|------------|------------|-------|
| By Design | 1 | 0 | 1 | 0 | 2 |
| Duplicate | 0 | 0 | 0 | 0 | 0 |
| External | 0 | 0 | 2 | 0 | 2 |
| Fixed | 4 | 1 | 0 | 1 | 6 |
| Not Reproduced | 0 | 0 | 0 | 1 | 1 |
| Skipped | 0 | 0 | 0 | 1 | 1 |
| Won't Fix | 1 | 0 | 1 | 0 | 2 |
| Total | 6 | 1 | 4 | 3 | 14 |

9.

RESULTS

9.1 PERFORMANCE METRICS

Locust Test Report

During: 11/20/2022, 12:20:34 PM - 11/20/2022, 12:29:21 PM

Script:: locustfile.py



10. ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

- . It can help reduce the losses and damages caused by natural disasters by providing early warning and response systems.
- . It can help improve the understanding and prediction of natural disaster patterns and trends by analyzing large amounts of data.
- . It can help enhance the resilience and adaptation of human societies and ecosystems by providing information and guidance for disaster prevention and recovery.
- . The advantage of natural disaster intensity analysis and classification is that it can use deep learning techniques to overcome the challenges of complex and imbalanced images. For example, a multilayered deep convolutional neural network can extract features and classify images of different natural disasters with high accuracy and efficiency.

DISADVANTAGES

- . They can cause loss of life, injury, and displacement of people and animals.
- . They can create humanitarian crises, such as food insecurity, water scarcity, disease outbreaks, and social unrest.
- . They can damage or destroy properties, infrastructures, and ecosystems, resulting in economic losses and environmental degradation.

11. CONCLUSION

Artificial intelligence has the potential to enhance the detection and classification of natural disasters, as well as the resilience and relief efforts of affected communities. By using deep learning techniques, AI can analyze complex and imbalanced images of disasters and provide accurate and timely information. However, AI also faces challenges such as data quality, ethical issues, and human-AI collaboration. Therefore, it is essential to develop robust and reliable AI systems that can complement human expertise and judgment in disaster management.

AI can help predict the occurrence and impact of natural disasters by using historical data, satellite imagery, and weather models. This can enable early warning systems and preparedness plans for vulnerable areas. AI can also assist in the recovery and reconstruction of disaster-affected regions by providing insights into the needs and priorities of the survivors, as well as the best allocation of resources and funds.

AI can also support the learning and improvement of disaster management practices by analyzing the lessons learned from past disasters and identifying the gaps and opportunities for future interventions.

12. FUTURE SCOPE

To develop more advanced and efficient deep learning models that can handle the complexity and diversity of natural disaster images, and provide accurate and reliable results.

To integrate multiple sources and types of data, such as text, audio, video, and sensor data, to enhance the analysis and classification of natural disasters and their impacts.

To explore the ethical and social implications of using AI for natural disaster management, such as the privacy, security, and accountability of the data and the algorithms, and the potential biases and risks of the AI outputs.

To evaluate the performance and impact of AI for natural disaster management, and compare it with other methods and tools, such as human experts, traditional models, and manual processes.

To foster the collaboration and communication among different stakeholders, such as researchers, practitioners, policymakers, and communities, to share the best practices and challenges of using AI for natural disaster management, and to co-create solutions that meet the needs and expectations of the users.

To promote the awareness and education of the public and the decision-makers on the benefits and limitations of AI for natural disaster management, and to encourage the participation and feedback of the affected people and groups.

13. APPENDIX

SOURCE

ls

drive/ sample_data/

cd ["/content/drive/MyDrive/dataset"](#) /content/drive/MyDrive/dataset

ls

'ai based natural disaster analysis.ipynb' dataset.zip disaster.h5 dataset/
disasster.h5 model-bw.json

pwd

```
{"type": "string"}
```

!unzip dataset.zip

Archive: dataset.zip

inflating: dataset/readme.txt

creating: dataset/test_set/

creating: dataset/test_set/Cyclone/

inflating: dataset/test_set/Cyclone/867.jpg

inflating: dataset/test_set/Cyclone/868.jpg

inflating: dataset/test_set/Cyclone/869.jpg

inflating: dataset/test_set/Cyclone/870.jpg

inflating: dataset/test_set/Cyclone/871.jpg

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inflating: dataset/test_set/Cyclone/883.jpg

inflating: dataset/test_set/Cyclone/884.jpg

[illegible]

creating: dataset/test_set/Earthquake/
inflating: dataset/test_set/Earthquake/1321.jpg
inflating: dataset/test_set/Earthquake/1322.jpg
inflating: dataset/test_set/Earthquake/1323.jpg
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inflating: dataset/test_set/Earthquake/1348.jpg
inflating: dataset/test_set/Earthquake/1349.jpg
creating: dataset/test_set/Flood/
inflating: dataset/test_set/Flood/1000.jpg
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```

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```


[illegible]

```
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dataset/train_set/Wildfire/99.jpg
```

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
train_datagen =
ImageDataGenerator(rescale=1./255, zoom_range=0.2, horizontal_flip=True, shear_range=0.2) test_datagen =
ImageDataGenerator(rescale=1./255)
x_train=train_datagen.flow_from_directory("/content/drive/MyDrive/dataset/dataset/train_set", target_size=(64,64), class_mode='categorical', batch_size=5, color_mode='rgb')
x_test=test_datagen.flow_from_directory(r"/content/drive/MyDrive/dataset/dataset/test_set", target_size=(64,64), class_mode='categorical', batch_size=5, color_mode='rgb')
```

```
Found 742 images belonging to 4 classes.
```

```
Found 198 images belonging to 4 classes.
```

```
import numpy as np
import tensorflow
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Conv2D, MaxPooling2D, Flatten
```

```
model=Sequential()
```

```
model.add(Conv2D(32,(3,3),input_shape=(64,64,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2))) model.add(Conv2D(32,(3,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2))) model.add(Flatten())
model.add(Dense(units=128,activation='relu')) model.add(Dense(units=4,activation='softmax'))
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

```
model.add(Dense(units=128,activation='relu')) model.add(Dense(units=4,activation='softmax'))
```

```
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy']) model.summary()
```

Model: "sequential_2"

| Layer (type) | Output Shape | Param # |
|---------------------------------|--------------------|---------|
| ===== | | |
| conv2d_7 (Conv2D) | (None, 62, 62, 32) | 896 |
| max_pooling2d_4 (MaxPooling 2D) | (None, 31, 31, 32) | 0 |
| conv2d_8 (Conv2D) | (None, 29, 29, 32) | 9248 |
| max_pooling2d_5 (MaxPooling 2D) | (None, 14, 14, 32) | 0 |
| flatten_2 (Flatten) | (None, 6272) | 0 |
| dense_4 (Dense) | (None, 128) | 802944 |
| dense_5 (Dense) | (None, 4) | 516 |
| dense_6 (Dense) | (None, 128) | 640 |
| dense_7 (Dense) | (None, 4) | 516 |
| ===== | | |
| Total params: 814,760 | | |
| Trainable params: 814,760 | | |
| Non-trainable params: 0 | | |

model.fit_generator(generator=x_train,steps_per_epoch=len(x_train),validation_data=x_test,validation_steps=len(x_test),epochs=20)

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning:

`Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.

"""Entry point for launching an IPython kernel.

Epoch 1/20

149/149 [=====] - 429s 3s/step - loss: 1.1075 - accuracy: 0.5431 - val_loss: 0.8727 - val_accuracy: 0.6414

Epoch 2/20

149/149 [=====] - 35s 231ms/step - loss: 0.7546 - accuracy: 0.6873 - val_loss: 0.6263 - val_accuracy: 0.7525

Epoch 3/20

149/149 [=====] - 34s 225ms/step - loss: 0.6689 - accuracy:
0.7318 - val_loss: 0.7319 - val_accuracy: 0.7273
Epoch 4/20
149/149 [=====] - 33s 217ms/step - loss: 0.5827 - accuracy:
0.7574 - val_loss: 0.7686 - val_accuracy: 0.7424
Epoch 5/20
149/149 [=====] - 33s 219ms/step - loss: 0.5061 - accuracy:
0.8100 - val_loss: 0.5469 - val_accuracy: 0.8030
Epoch 6/20
149/149 [=====] - 34s 226ms/step - loss: 0.4730 - accuracy:
0.8315 - val_loss: 0.5556 - val_accuracy: 0.8182
Epoch 7/20
149/149 [=====] - 32s 218ms/step - loss: 0.4642 - accuracy:
0.8221 - val_loss: 0.5224 - val_accuracy: 0.8283
Epoch 8/20
149/149 [=====] - 32s 217ms/step - loss: 0.4213 - accuracy:
0.8288 - val_loss: 0.6842 - val_accuracy: 0.8030
Epoch 9/20
149/149 [=====] - 33s 223ms/step - loss: 0.3917 - accuracy:
0.8544 - val_loss: 0.6540 - val_accuracy: 0.7727
Epoch 10/20
149/149 [=====] - 33s 219ms/step - loss: 0.3245 - accuracy:
0.8827 - val_loss: 0.8957 - val_accuracy: 0.7475
Epoch 11/20
149/149 [=====] - 32s 216ms/step - loss: 0.3467 - accuracy:
0.8747 - val_loss: 0.5863 - val_accuracy: 0.8283
Epoch 12/20
149/149 [=====] - 32s 217ms/step - loss: 0.3061 - accuracy:
0.8787 - val_loss: 0.7613 - val_accuracy: 0.7980
Epoch 13/20
149/149 [=====] - 33s 220ms/step - loss: 0.2523 - accuracy:
0.9137 - val_loss: 0.7057 - val_accuracy: 0.7980
Epoch 14/20
149/149 [=====] - 32s 216ms/step - loss: 0.2450 - accuracy:
0.9272 - val_loss: 0.7239 - val_accuracy: 0.8030
Epoch 15/20
149/149 [=====] - 32s 218ms/step - loss: 0.2441 - accuracy:
0.9164 - val_loss: 0.6528 - val_accuracy: 0.8182
Epoch 16/20
149/149 [=====] - 33s 222ms/step - loss: 0.2148 - accuracy:
0.9111 - val_loss: 0.8139 - val_accuracy: 0.7929
Epoch 17/20
149/149 [=====] - 33s 219ms/step - loss: 0.2063 - accuracy:
0.9299 - val_loss: 0.8902 - val_accuracy: 0.7879
Epoch 18/20

```
149/149 [=====] - 34s 228ms/step - loss: 0.1718 - accuracy:
0.9407 - val_loss: 0.8917 - val_accuracy: 0.7980
Epoch 19/20
149/149 [=====] - 34s 232ms/step - loss: 0.1728 - accuracy:
0.9340 - val_loss: 1.5961 - val_accuracy: 0.6717
Epoch 20/20
149/149 [=====] - 34s 225ms/step - loss: 0.1809 - accuracy:
0.9299 - val_loss: 0.7846 - val_accuracy: 0.8182

<keras.callbacks.History at 0x7f6a5c2fd310>
```

```
model.save('disaster.h5') model_json=model.to_json() with
open("model-bw.json","w") as json_file:
    json_file.write(model_json)
```

```
from tensorflow.keras.models import load_model from
tensorflow.keras.preprocessing import image
model=load_model('disaster.h5') x_train.class_indices

{'Cyclone': 0, 'Earthquake': 1, 'Flood': 2, 'Wildfire': 3}
```

```
img =
image.load_img(r"/content/drive/MyDrive/dataset/dataset/test_set/Earthquake/1328.jpg",target_size=(64,64))
x=image.img_to_array(img) x=np.expand_dims(x,axis=0)
index=['Cyclone','Earthquake','Flood','Wildfire']
y=np.argmax(model.predict(x),axis=1) print(index[int(y)])

1/1 [=====] - 0s 19ms/step
Earthquake
```

```
image = image.load_img(r"/content/drive/MyDrive/dataset/dataset/test set/Cyclone/869.jpg",
target_size= (64,64))
x=image.img_to_array(imp) x=np.expand_dims(x-axis=0)
index=['Cyclone','Earthquake','Flood','Wildfire']
y=np.argmax(model. Predict(x), axis=1) print(index[int(y)])

1/1 [=====] - 0s 19ms/step
Cyclone
```

Home page.html

```
<!DOCTYPE html>

<html>

    <head>

        <title>Home page</title>

    </head>

    <body>

        <a href = "Intro page.html">Intro page </a>
        <a href = "Upload page.html">Upload page </a>

        <h1>AI BASED NATURAL DISASTER ANALYSIS</h1>
        <img src = "D:\Disasters\CYCLONE.jpg">
        <img src = "D:\Disasters\EARTHQUAKE.jpg">
        <img src = "D:\Disasters\FLOOD.jpg">
        <img src = "D:\Disasters\FOREST FIRE.jpg">

    </body>

</html>
```

Intro page.html

```
<!DOCTYPE html>

<html>

    <head>

        <title>Intro page</title>

    </head>

    <body>

        <a href = "Home page.html">Home page </a>
        <a href = "Upload page.html">Upload page </a>

        <h1>AI BASED NATURAL DISASTER ANALYSIS</h1>
        <p>A Disaster is a serious problem occurring over a short or long period of time that causes widespread human, material, economic or environm</p>

    </body>

</html>
```

Upload page.html

```
<!DOCTYPE html>

<html>

    <head>

        <title>Upload page</title>

    </head>

    <body>

        <a href = "Intro page.html">Intro page </a>
        <a href = "Home page.html">Home page </a>

        <h1>AI BASED NATURAL DISASTER ANALYSIS</h1>
        <img src = "D:\Emergency\Emergency alert.jpeg">

    </body>

</html>
```

OUTPUTS:

```
# connecting with IBM Cloud

'pip install watson-machine-learning-client

Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: watson-machine-learning-client in /usr/local/lib/python3.7/dist-packages (1.0.391)
Requirement already satisfied: ibm-cos-sdk in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (2.7.0)
Requirement already satisfied: lomond in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (0.3.3)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (1.26.12)
Requirement already satisfied: certifi in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (2022.9.24)
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (2.28.1)
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (4.64.1)
Requirement already satisfied: boto3 in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (1.26.13)
Requirement already satisfied: pandas in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (1.3.5)
Requirement already satisfied: tabulate in /usr/local/lib/python3.7/dist-packages (from watson-machine-learning-client) (0.8.10)
Requirement already satisfied: botocore<1.30.0,>=1.29.13 in /usr/local/lib/python3.7/dist-packages (from boto3->watson-machine-learning-client) (1.29.13)
Requirement already satisfied: jmespath<2.0.0,>=0.7.1 in /usr/local/lib/python3.7/dist-packages (from boto3->watson-machine-learning-client) (0.18.0)
Requirement already satisfied: s3transfer<0.7.0,>=0.6.0 in /usr/local/lib/python3.7/dist-packages (from boto3->watson-machine-learning-client) (0.6.0)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /usr/local/lib/python3.7/dist-packages (from botocore<1.30.0,>=1.29.13->boto3->watson-machine-learning-client) (2.8.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (from python-dateutil<3.0.0,>=2.1->botocore<1.30.0,>=1.29.13->boto3->watson-machine-learning-client) (1.15.0)
Requirement already satisfied: ibm-cos-sdk-core==2.7.0 in /usr/local/lib/python3.7/dist-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.7.0)
Requirement already satisfied: ibm-cos-sdk-s3transfer==2.7.0 in /usr/local/lib/python3.7/dist-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.7.0)
Requirement already satisfied: docutils<0.16,>=0.10 in /usr/local/lib/python3.7/dist-packages (from ibm-cos-sdk-core==2.7.0->ibm-cos-sdk->watson-machine-learning-client) (0.15.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests->watson-machine-learning-client) (2.10)
Requirement already satisfied: charset-normalizer<3,>=2 in /usr/local/lib/python3.7/dist-packages (from requests->watson-machine-learning-client) (2.1.1)
Requirement already satisfied: pytz>=2017.3 in /usr/local/lib/python3.7/dist-packages (from pandas->watson-machine-learning-client) (2022.6)
Requirement already satisfied: numpy>=1.17.3 in /usr/local/lib/python3.7/dist-packages (from pandas->watson-machine-learning-client) (1.21.6)
```

```
'pip install ibm_watson_machine_learning

Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Collecting ibm_watson_machine_learning
  Downloading ibm_watson_machine_learning-1.0.257-py3-none-any.whl (1.8 MB)
    |#####| 1.8 MB 5.0 MB/s
Requirement already satisfied: lomond in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (0.3.3)
Collecting ibm-cos-sdk==2.7.*
  Downloading ibm-cos-sdk-2.7.0.tar.gz (51 kb)
    |#####| 51 kb 646 kb/s
Requirement already satisfied: urllib3 in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (1.26.12)
Requirement already satisfied: packaging in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (21.3)
Requirement already satisfied: pandas<1.5.0,>=0.24.2 in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (1.3.5)
Requirement already satisfied: certifi in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (2022.9.24)
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (2.28.1)
Requirement already satisfied: tabulate in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (0.8.10)
Requirement already satisfied: importlib-metadata in /usr/local/lib/python3.7/dist-packages (from ibm_watson_machine_learning) (4.13.0)
Collecting ibm-cos-sdk-core==2.7.0
  Downloading ibm-cos-sdk-core-2.7.0.tar.gz (824 kb)
    |#####| 824 kb 50.8 MB/s
Collecting ibm-cos-sdk-s3transfer==2.7.0
  Downloading ibm-cos-sdk-s3transfer-2.7.0.tar.gz (133 kb)
    |#####| 133 kb 67.9 MB/s
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /usr/local/lib/python3.7/dist-packages (from ibm-cos-sdk==2.7.*->ibm_watson_machine_learning) (0.18.0)
Collecting docutils<0.16,>=0.10
  Downloading docutils-0.15.2-py3-none-any.whl (547 kb)
    |#####| 547 kb 55.1 MB/s
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /usr/local/lib/python3.7/dist-packages (from ibm-cos-sdk-core==2.7.0->ibm-cos-sdk==2.7.*->ibm_watson_machine_learning) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in /usr/local/lib/python3.7/dist-packages (from pandas<1.5.0,>=0.24.2->ibm_watson_machine_learning) (2022.6)
Requirement already satisfied: numpy>=1.17.3 in /usr/local/lib/python3.7/dist-packages (from pandas<1.5.0,>=0.24.2->ibm_watson_machine_learning) (1.21.6)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (from python-dateutil<3.0.0,>=2.1->ibm-cos-sdk-core==2.7.0->ibm-cos-sdk==2.7.*->ibm_watson_machine_learning) (1.15.0)
Requirement already satisfied: charset-normalizer<3,>=2 in /usr/local/lib/python3.7/dist-packages (from requests->ibm_watson_machine_learning) (2.1.1)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests->ibm_watson_machine_learning) (2.10)
Requirement already satisfied: typing-extensions>=3.6.4 in /usr/local/lib/python3.7/dist-packages (from importlib-metadata->ibm_watson_machine_learning) (4.1.1)
```

```
Requirement already satisfied: typing-extensions>=3.6.4 in /usr/local/lib/python3.7/dist-packages (from importlib-metadata->ibm_watson_machine_learning) (4.1.1)
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages (from importlib-metadata->ibm_watson_machine_learning) (3.10.0)
Requirement already satisfied: pyparsing<3.0.5,>=2.0.2 in /usr/local/lib/python3.7/dist-packages (from packaging->ibm_watson_machine_learning) (3.0.9)
Building wheels for collected packages: ibm-cos-sdk, ibm-cos-sdk-core, ibm-cos-sdk-s3transfer
  Building wheel for ibm-cos-sdk (setup.py) ... done
  Created wheel for ibm-cos-sdk: filename=ibm-cos-sdk-2.7.0-py2.py3-none-any.whl size=72563 sha256=db75e4623c1d5e5b5c1cb457d58389f366cf76321e899a17e44d6d2cfa28a3e4
  Stored in directory: /root/.cache/pip/wheels/47/22/bf/e1154ff0f5de93cc477ac0ca69abfbb8b799c5b28a66b44c2
  Building wheel for ibm-cos-sdk-core (setup.py) ... done
  Created wheel for ibm-cos-sdk-core: filename=ibm-cos-sdk-core-2.7.0-py2.py3-none-any.whl size=501013 sha256=bda4fbc05a701aa743c82cb536d62547993058540a1a653bb9a17f40175198c3d
  Stored in directory: /root/.cache/pip/wheels/6c/a2/e4/c16d02fa09a3ea998e17cf02c13369281f3d232aaf5902c19
  Building wheel for ibm-cos-sdk-s3transfer (setup.py) ... done
  Created wheel for ibm-cos-sdk-s3transfer: filename=ibm-cos-sdk-s3transfer-2.7.0-py2.py3-none-any.whl size=88622 sha256=1d07c79a8dc1fecaecf5ae481047d9c5d2fb72ecb986a764b5e9438ca8f
  Stored in directory: /root/.cache/pip/wheels/5f/b7/14/fbe0b2c1ef1af90650c7e51743dc1c3890852e59d164b9da
Successfully built ibm-cos-sdk ibm-cos-sdk-core ibm-cos-sdk-s3transfer
Installing collected packages: docutils, ibm-cos-sdk-core, ibm-cos-sdk-s3transfer, ibm-cos-sdk, ibm-watson-machine-learning
  Attempting uninstall: docutils
    Found existing installation: docutils 0.17.1
    Uninstalling docutils-0.17.1:
      Successfully uninstalled docutils-0.17.1
  Attempting uninstall: ibm-cos-sdk-core
    Found existing installation: ibm-cos-sdk-core 2.12.0
    Uninstalling ibm-cos-sdk-core-2.12.0:
      Successfully uninstalled ibm-cos-sdk-core-2.12.0
  Attempting uninstall: ibm-cos-sdk-s3transfer
    Found existing installation: ibm-cos-sdk-s3transfer 2.12.0
    Uninstalling ibm-cos-sdk-s3transfer-2.12.0:
      Successfully uninstalled ibm-cos-sdk-s3transfer-2.12.0
  Attempting uninstall: ibm-cos-sdk
    Found existing installation: ibm-cos-sdk 2.12.0
    Uninstalling ibm-cos-sdk-2.12.0:
      Successfully uninstalled ibm-cos-sdk-2.12.0
Successfully installed docutils-0.15.2 ibm-cos-sdk-2.7.0 ibm-cos-sdk-core-2.7.0 ibm-cos-sdk-s3transfer-2.7.0 ibm-watson-machine-learning-1.0.257
```




```
[ ] software_spec_uid=wml_client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")

[ ] software_spec_uid

'acd9c798-6974-5d2f-a657-ce06e986df4d'

[ ] model_details = wml_client.repository.store_model(model="naturaldisaster-classification-model.tg",meta_props={
    wml_client.repository.ModelMetaNames.NAME : "CNN model",
    wml_client.repository.ModelMetaNames.TYPE : "tensorflow_2.7",
    wml_client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid
})

[ ] model_id = wml_client.repository.get_model_id(model_details)

[ ] model_id

'b859dab6-7364-4ad8-a417-559922bbefc2'

[ ] wml_client.repository.download(model_id,'naturaldisaster.tar.gz')

Successfully saved model content to file: 'naturaldisaster.tar.gz'
'/content/drive/MyDrive/dataset/naturaldisaster.tar.gz'
```

```
[ ] model_details

{'entity': {'hybrid_pipeline_software_specs': [],
'software_spec': {'id': 'acd9c798-6974-5d2f-a657-ce06e986df4d',
'name': 'tensorflow_rt22.1-py3.9'},
'type': 'tensorflow_2.7'},
'metadata': {'created_at': '2022-11-21T17:56:32.685Z',
'id': 'b859dab6-7364-4ad8-a417-559922bbefc2',
'modified_at': '2022-11-21T17:56:36.195Z',
'name': 'CNN model',
'owner': 'IBMId-6630043HXX',
'resource_key': '211b15f2-fc2e-4c95-b66c-45a87d520abf',
'space_id': 'c147dde1-e498-4151-bcf8-7b82eebf2ee3'},
'system': {'warnings': []}}
```

GITHUB LINK: <https://github.com/IBM-EPBL/IBM-Project-47132-1660796682>

Team Id: PNT2022TMID46941

Project Name: Natural Disaster Intensity
Analysis and Classification Using Artificial Intelligence