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## **NATURAL DISASTERS INTENSITY ANALYSIS AND CLASSIFICATION USING ARTIFICIAL INTELLIGENCE**

### **INTRODUCTION**

#### **1.1 PROJECT OVERVIEW**

Natural disasters not only disturb the human ecological system but also destroy the properties and critical infrastructures of human societies and even lead to permanent change in the ecosystem. Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. Many deep learning techniques have been applied by various researchers to detect and classify natural disasters to overcome losses in ecosystems, but detection of natural disasters still faces issues due to the complex and imbalanced structures of images. To tackle this problem, we propose a multilayered deep convolutional neural network.

#### **1.2 Purpose**

Natural disasters are inevitable, and the occurrence of disasters drastically affects the economy, ecosystem and human life. Buildings collapse, ailments spread and some major natural disasters such as tsunamis, earthquakes, and forest fires can devastate nations. When earthquakes occur, millions of buildings collapse due to seismological effects [1]. Many machine learning approaches have been used for wildfire predictions since the 1990s. A recent study used a machine learning approach in Italy. This study used the random forest technique for susceptibility mapping of wildfire. Floods are the most devastating natural disaster, damaging properties, human lives and infrastructures. To map flood susceptibility, an

assembled machine learning technique based on random forest (RF), random subspace (RS) and support vector machine (SVM) was used [3]. As the population is growing rapidly, people need to acquire land to live on, and as a result the ecosystem is disturbed horrifically, which causes global warming and increases the number of natural disasters. Populations in underdeveloped countries cannot afford damages disasters cause to infrastructures. The aftermath of disasters leaves the humans in miserable situations, and sometimes the devastating effects cannot be detected; additionally, rescue operations cannot take place in most of the places and victims are unable to be identified due to geographical factors of the different areas. Disasters such as forest fires spread rapidly in dense areas, so firefighting is difficult to carry out; in this case, development of the strategy to predict such circumstances is crucial so that such disasters can be prevented beforehand.

## **2. LITERATURE SURVEY**

### **2.1 Existing system**

Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. Many deep learning techniques have been applied by various researchers to detect and classify natural disasters to overcome losses in ecosystems, but detection of natural disasters still faces issues due to the complex and imbalanced structures of images.

### **2.2 REFERENCES**

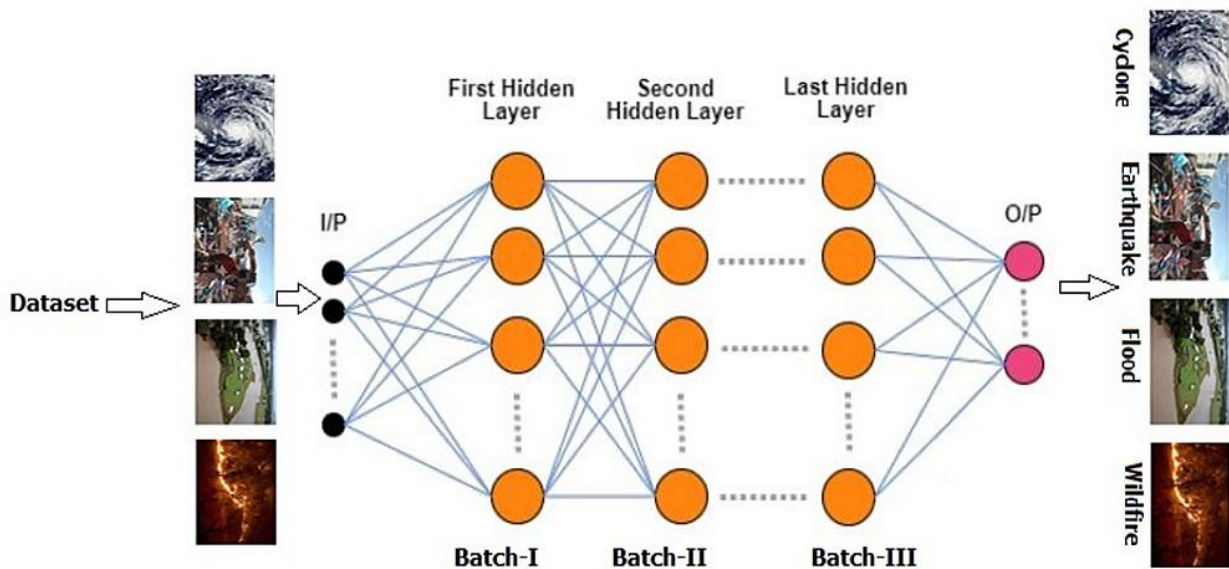
Adams, G., O'Brien, L. T., & Nelson, J. C. (2006). Perceptions of racism in Hurricane Katrina: A liberation psychology analysis. *Analyses of Social Issues and Public Policy*, 6(1), 215–235. Aguirre, B. E. (1988). The lack of warnings before the Saragosa tornado. *International Journal of Mass Emergencies and Disasters*, 6(1), 65–74. Al-rousan, T. M., Rubenstein, L. M., & Wallace, R. B. (2014, March). Preparedness for natural disasters among older U.S. adults: A nationwide survey. *American Journal of Public Health*, 104(3), 506–511. doi: 10.2105/AJPH.2013.301559 Austin, R., & Schill, M. (1994). *Unequal protection*. San Francisco, CA: Sierra Club Books. Bolin, B. (2007). Race, class, ethnicity, and disaster vulnerability. *Handbook of disaster research* (pp. 113–129). New York, NY:

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### 2.3 Problem statement definition

The natural disaster intensity analysis and classification is based on multispectral images using a multilayered deep convolutional neural network. Moreover, this method consists of two blocks of a convolutional neural network. The first block detects a natural disaster occurring and the second one defines the intensity type of the natural disaster. Additionally, the first block consists of three mini convolutional blocks with four layers each, including an image input and fully connected layers. On the other hand, the second block also consists of three mini convolutional blocks with two layers each and includes an image input layer and is fully connected.

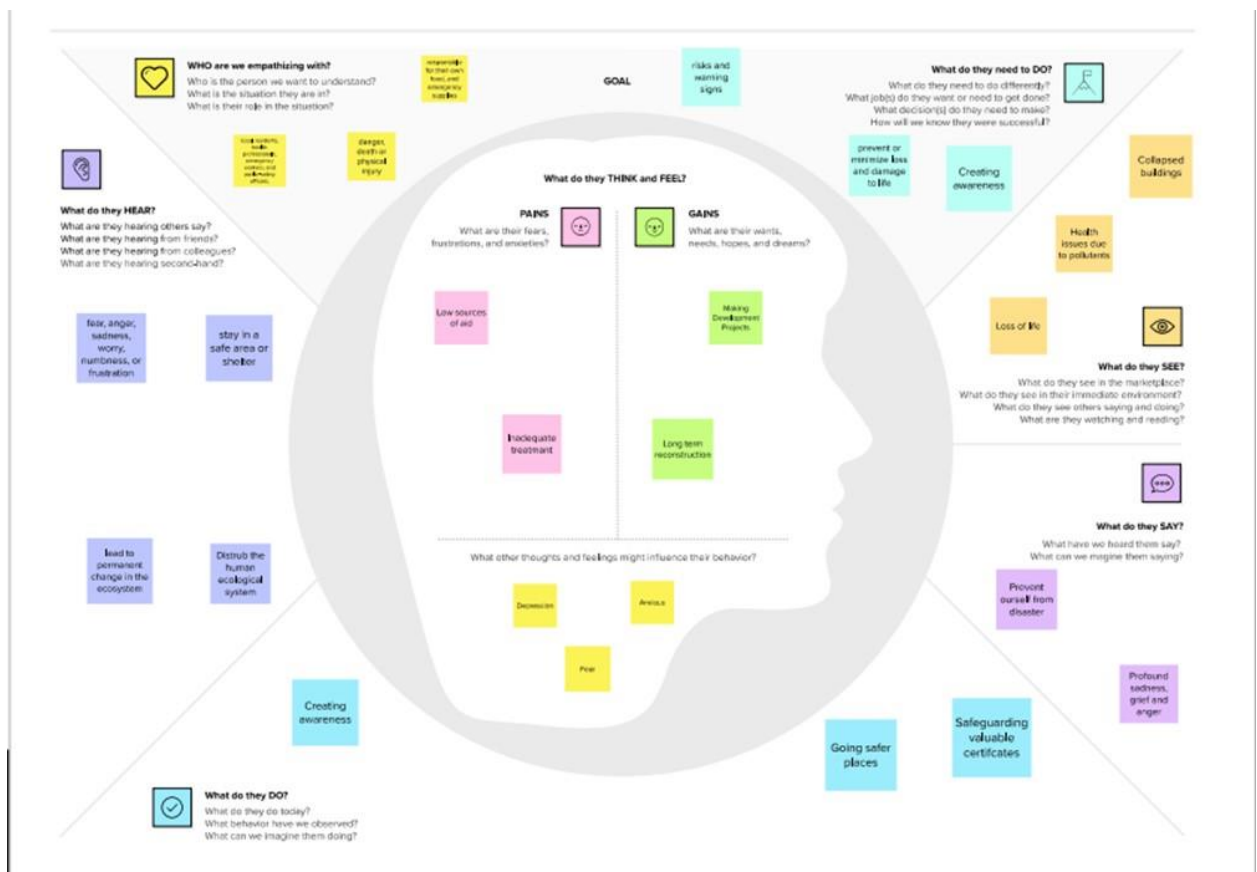


### 3. IDEATION & PROPOSED SOLUTION

### 3.1 Empathy map canvas

An empathy map is an effective visualization template that helps analyze the behavior and emotions of customers and users. Empathy maps not only detect the behaviors but highlight possible mediums for brands to communicate with their customers in a better way. Whether this is changing their outreach strategies, user experience, or messaging, an empathy map aims to view a given interaction through the customer's eyes and improve it from their perspective.

Empathy maps are beneficial in uniting a team to address the core concerns of the customer and ensuring that this process both documents their frustrations and provides a consumer-informed solution.

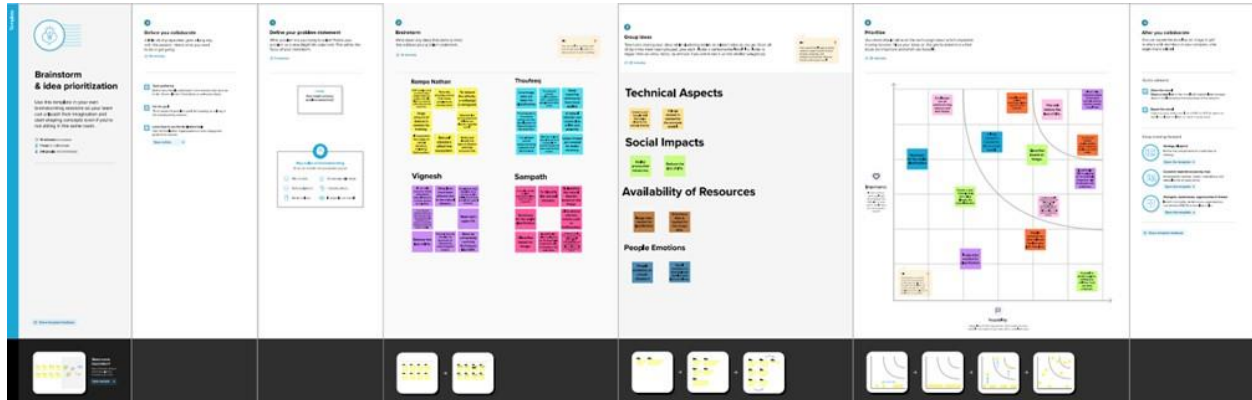


### 3.2 Brainstorm & Idea Priorization Template:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built

upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.



### 3.3 Proposed solution

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To analyse and classify the intensity of the natural disaster using Artificial Intelligence.
2.	Idea / Solution description	To propose a Convolutional Neural Network model for detection and classification of disaster intensity.
3.	Novelty / Uniqueness	The proposed model works in two blocks of convolutional neural network.
4.	Social Impact / Customer Satisfaction	Provides better accuracy in analysing intensities which enables better prediction of disaster
5.	Business Model (Revenue Model)	The model works efficiently and effectively with better accuracy for customers.
6.	Scalability of the Solution	Enhances collaboration between current and past initiatives and provides better accuracy and prediction. The used algorithms and CNN model made the analysis and classification easier.

### 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. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

#### Purpose:

Solve complex problems in a way that fits the state of your customers.

Succeed faster and increase your solution adoption by tapping into existing mediums and channels of behavior.

Sharpen your communication and marketing strategy with the right triggers and messaging.

Increase touch-points with your company by finding the right problem-behavior fit and building trust by solving frequent annoyances, or urgent or costly problems.

Understand the existing situation in order to improve it for your target group.

## 4. Requirement Analysis

### 4.1 Functional Requirement:

Following are the functional requirements of the proposed solution

FR NO	FUNCTIONAL REQUIREMENT	SUB REQUIREMENT
FR-1	User Registration	Registration through form Registration through gmail Registration through linkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Profile	Personal Details

FR-4	Informa on about weather forecas ng	Helps to determine future climate change
FR-5	Display the forecas ng of the place	Such as Precipita on, Humidity, Wind

## 4.2 Non-func onal Requirements:

Following are the non-func onal requirements of the proposed solu on.

FR NO.	NON-FUNCTIONAL REQUIREMENTS	DESCRIPTION
NRF-1	Usability	Classifying disasters and prone to it.
NRF-2	Security	User details must be secured.
NRF-3	Reliability	The output procedure should be reliable to the users.



NRF-4	Performance	The system should be able to handle many users without performance deterioration.
NRF-5	Availability	The system should be accessible to a user at a given point in time.
NRF-6	Scalability	The website pages should load with the total number of simultaneous users.

## 5.PROJECT PLANNING

### 5.1 DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirements graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

### 5.3 USER STORIES

Use the below template to list all the user stories for the product.

USER TYPE	FUNCTIONAL REQUIREMENT	USER STORY NUMBER	USER STORY/TASK	ACCEPTANCE CRITERIA	PRIORITY	RELEASE

Customer(Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive	I can receive	High	Sprint-1

			confirmation email once I have registered for the application	confirmation email & click confirm		
		USN-3	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application email & password		High	Sprint-1

	Dashboard					
Customer (Web user)		USN-5	As a user, you can view edit your personal details	I can edit and view my details	Low	Sprint-2
		USN-6	As a user, you can determine future climatic changes	I can check on information about weather forecast	High	Sprint-2
Administrator		USN-7	As a admin you can	I can display	Medium	Sprint-3
			provide or display the requested details form user such as displaying forecasted weather of the place	forecasted details about weather.		

## 6. PROJECT PLANNING & SCHEDULING

### 6.1 Sprint Planning & Estimation

<b>TITLE</b>	<b>DESCRIPTION</b>	<b>DATE</b>
<b>Literature Survey &amp; Information Gathering</b>	Literature survey on the selected project & gathering information by referring to technical papers, research publications etc.	16 OCTOBER 2022
<b>Prepare Empathy Map</b>	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	09 OCTOBER 2022
<b>Prepare Problem Statement</b>	Prepare the list of problem statements	09 OCTOBER 2022
<b>Ideation</b>	List them by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	16 OCTOBER 2022
<b>Proposed Solution</b>	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	10 OCTOBER 2022
<b>Problem Solution Fit</b>	Prepare problem - solution fit document.	10 OCTOBER 2022
<b>Solution Architecture</b>	Prepare a solution architecture document.	11 OCTOBER 2022

<b>Customer Journey</b>	Prepare the user journey maps to understand the user interactions & experiences with the application (entry to exit).	18 OCTOBER 2022
<b>Solution Requirement</b>	Prepare the solution requirement document.	16 OCTOBER 2022
<b>Data Flow Diagrams</b>	Draw the data flow diagrams and submit for review.	18 OCTOBER 2022
<b>Technology Architecture</b>	Prepare the technology architecture diagram.	17 OCTOBER 2022
<b>Prepare Milestone &amp; Activity List</b>	Prepare the milestones & activity list of the project.	7 NOVEMBER 2022
<b>Project Development - Delivery of Sprint-1, 2, 3 &amp; 4</b>	Develop & submit the developed code by testing it.	18 NOVEMBER 2022

## 7. CODING & SOLUTIONING (Explain the features added in the project along with code)

### 7.1 FEATURE 1

```
from google.colab import drive
drive.mount('/content/drive')

import numpy as np
import pandas as pd
import tensorflow as tf
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt

train_datagen=ImageDataGenerator(rescale=1./255, shear_range=0.2, zoom_range=0.2, horizontal_flip=True)
test_datagen=ImageDataGenerator(rescale=1./255)

x_train=train_datagen.flow_from_directory('/content/drive/MyDrive/IBM- PROJECT/dataset/train_set',
target_size=(64,64), batch_size=5, color_mode='rgb', class_mode='categorical')
x_test=test_datagen.flow_from_directory('/content/drive/MyDrive/IBM- PROJECT/dataset/train_set',
target_size=(64,64), batch_size=5, color_mode='rgb', class_mode='categorical')

from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D

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.summary()

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

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")
```

```

img=image.load_img('/content/drive/MyDrive/dataset/test_set/
Earthquake/1321.jpg',target_size=(64,64)) x=image.img_to_array(img) x=np.expand_dims(x,axis=0)
pred=model.predict(x)np.argmax(pred) pred

index=['Cyclone','Earthquake','Flood','Wildfire']

y=np.argmax(model.predict(x),axis=1) print(index[int(y)])

```

## 7.2 FEATURE 2

### home.html

```

<html>
  <head><title>homepage</title>
  <style>
    .Main{ background-color:
      dimgray; justify-content:
      center; align-items:
      center; height:
      100%;
      display: flex;
    }
    .navbar
    {
      background-color: black;
      color: chartreuse; width:
      100%; height: 40
    }
  </style>
</html>

```

```

        px;
    }
    .navbar ul
    {
        display: flex;        justify-
        content: flex-end;    align-
        content: spacebetween;
        list-style: none; margin-
        top: -10px;
    }
    .navbar label
    {
        font-size:
        25px; marginleft:
        40px; font-weight:
        bold;
    } ul
    li
    {
        width: 15%;
        font-size: 20px;
        font-weight:
        bold;
        margintop:-
        10px;
        font-family: Cambria,Cochin, Georgia, Times,'Times New Roman',serif;
    }
    li a
    {
        text-decoration: none;color:whites
        moke;
    }
    a:hover
    {
        background-color:chartreuse;

        border-radius: 5px;
    }
    .container

```

```
{
  width:80%;
  height:80%;
  margin:40px 50px;
  display: flex;
}
.disaster
{
  width:800px; height: 400px;
  margin-left: 15px; box-shadow:-
  1px 0 10px whitesmoke; align-
  items: center; justify-content:
  center; text-align:
  center;
}
img{ width:
  250px;
  height:200
  px;
}
.title
{ text-align:
  center; color:
  chartreuse;
  font-size:
  25px;
  fontweight:
  bold;
}
p{
  text-align: center;
  color:
  whitesmoke; font-
  size:
  15px;

}
</style>
</head>
<body>
```



src="data:image/jpeg;base64,/9j/4AAQSkZJRgABAQAAQAABAAAD/2wCEAAAGBwgHBGkIB  
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/tM6qTCET8Wk89wRy25SO2I8/wDauspKMiQf6QRHQj0lXrGYq21syirJp105ojQDeoJMbB  
CZ hT0A6YS5vhDsGc1Cp5R6d5t2xmMx6lpNHC3YoX7NMw1Gqb/0j9caxmMxNlq2f//Z"><d  
iv class="title">Flood<P>Floods are the most frequent type of natural disaster and occur when an  
overflow of water submerges land that is usually dry. Floods are often caused by heavy rainfall,  
rapid snowmelt or a storm surge from a tropical cyclone or tsunami in coastal areas.

</P></div></div>

<div class="disaster"><div  
class="title">Earthquake<P>An earthquake is a phenomenon that occurs without warning and

involves violent shaking of the ground and everything over it. It results from the release of accumulated stress of the moving lithospheric or crustal plates.</P></div></div>

</div>  
</div>  
</body>  
</html>

Intro.html

```
<html>  
  <head><title>homepage</title>  
  <style>  
    .Main{ background-  
      color:darkcyan; justify-  
      content: center; align-items:  
      center; height: 100%;  
      display:flex;  
    }  
    .navbar  
    {  
      background-color:darkgrey;  
      color:black; width:  
      100%;  
      height:40px;  
    }  
    .navbar ul  
    {  
      display:flex; justify-content:flex-end;  
      align-content: space-between;  
      list-style: none; margin-top: -  
      10px;  
    }  
    .navbar label  
    {  
      font-size: 25px; margin-left:  
      40px;  
      font-weight: bold;
```



```

    } ul
li
{
    width: 15%; font-
    size: 20px; font-
    weight: bold;
    margin-top:-10px;
    font-family: Cambria, Cochin, Georgia,Times, 'Times New Roman', serif;
}
li a
{
    text-decoration:
    none;color:whitesmok
    e;
}
a:hover
{
    background-color:darkcyan;

    border-radius: 5px;
}
.Main
{ text-align:
center;color:whea
t;
font-family:'Segoe UI', Tahoma, Geneva,Verdana, sans-serif; font-size:
12px;
}
</style>
</head>
<body>
    <nav class="navbar">
        <label>AI BasedNatural-Disaster-Analysis</label> <ul>

            <li><a href="C:/Users/DELL/IBM-PROJECT/flask/template/home.html">Home</a></li>
            <li><a href="C:/Users/DELL/IBM-PROJECT/flask/template/intro.html">Introduction</a></li>
            <li><a href="openwebcam.html">Open Web Cam</a></li> </ul>
        </nav>

```

```

<div class="Main">
  <h1>
    <span> China, India and the United States </span> <span> are among the countries
of the world most </span> <span> affected by natural disasters. </span> <span> Natural
disasters have the potential to wreck and even end the lives of those people,</span> <span> who
stand in their way.</span> <span> However, whether or not you are likely to be
</span> <span> affected by a natural disaster greatly depends</span> <span> on where in the world
you live,</span>
    <span> The objective of </span> <span> the project is to</span> <span> human build a
</span> <span> web application </span> <span> to detect the </span> <span> type of disaster
.</span> <span> The input </span> <span> is taken from the in built web cam,</span>
    <span> which in turn </span> <span> is </span> <span> given to the </span> <span>
<span> pre trained model .</span> <span> The model predicts the </span> <span> type of disaster
</span> <span> and displayed</span> <span> on UI.</span>

  </h1>
</div>
</body>
</html>

```

## upload.html

```

<html>
  <head><title>homepage</title>
  <style>
    .Main{
      background-color: azure;
      justify-content: center;
      align-items: center; height:
      100%;
      display: flex;
    }
    .navbar
    {
      background-color: rgb(238, 81, 81); color: darkslategrey; width:
      100%;
      height: 40px;
    }
  </style>

```

```

.navbar ul
{
    display:flex; justify-content:flex-end;
    align-content: space-between;
    list-style: none; margin-top: -
    10px;
}
.navbar label
{
    font-size: 25px; margin-left:
    40px;
    font-weight: bold;
} ul
li
{
    width: 15%; font-
    size: 20px; font-
    weight: bold;
    margin-top:-10px;
    font-family: Cambria, Cochin, Georgia,Times, 'Times New Roman', serif;
}
li a
{
    text-decoration:
    none;color:black;
}
a:hover
{
    background-color:honeydew;

    border-radius: 5px;
}
.Main
{ text-align:
center;color:whea
t;
font-family:'Segoe UI', Tahoma, Geneva,Verdana, sans-serif; font-size:
12px;
}

```

```

img{
  height: 80%; width:
  100%;
}
</style>
</head>
<body>
  <nav class="navbar">
    <label>AI BasedNatural-Disaster-Analysis</label> <ul>

      <li><a
href="C:/Users/MAHALAKSHMI%20G/Downloads/buildhtml/home.html">Home</a></li>
      <li><a
href="C:/Users/MAHALAKSHMI%20G/Downloads/buildhtml/intro.html">Introduction</a></li>
      <li><a
href="C:/Users/MAHALAKSHMI%20G/Downloads/buildhtml/openwebcam.html">Open Web
Cam</a></li>
    </ul>
  </nav>
  <div class="Main">
    
  </div>
</body>
</html>

```

## app.py

```

from flask import Flask,request,redirect,url_for,render_template from werkzeug.utils import
secure_filename import os app=Flask(__name__)
app.config['images']='C:\\Users\\DELL\\Downloads\\AI-BASED-NDA\\Flask\\static\\images'
@app.route('/home',methods=['GET']) render_template('intro.html')
@app def home():

```

```

    return render_template('home.html')
@app.route('/home/intro',methods=['GET']) def
intro():
    return.route("/",methods=["POST","GET"]) def
upload():
    if request.method=="POST":
        print(request.files)

        image=request.files['file']
        if image.filename=="":
            print("filename is invalid")
            return redirect(request.url)
        filename=secure_filename(image.filename)
        basedir=os.path.abspath(os.path.dirname(__file__))
        image.save(os.path.join(basedir,app.config["images"],filename))
        return render_template("upload.html",filename=filename)
    return render_template('upload.html')
@app.route('/display/<filename>') def
display(filename):
    return redirect(url_for('static',filename = '/images/'+filename),code=301)

app.run(port=5000)

```

## 8. Testing

### 8.1 Use cases

USER TYPE	FUNCTION AL REQUIREM ENT	USER STORY NIMBER	USER STORY/ TASK	ACCEPTAN CE CRITERIA	PRIORITY	RELEASE

Customer( Mobile user)	Registrati on	USN-1	As a user, I can register for the application by entering my email, password, and comfirming my password	I can access my account/ dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmati on email once I have registered for the application	I can receive confirmati on email & click confirm	High	Sprint-1
		USN-3	As a user, I can		Medium	Sprint-1

			register for the application through Gmail			
	Login	USN-4	As a user, I can log into the application email & password		High	Sprint-1

	Dashboard					
Customer (Web user)		USN-5	As a user, you can view edit your personal details	I can edit and view my details	Low	Sprint-2
		USN-6	As a user, you can determine future climatic changes	I can check on informati on about weather forecast	High	Sprint-2
Administra tor		USN-7	As a admin you can provide or display the requested details form user such as displaying forecasted weather of	I can display forecasted details about weather.	Medium	Sprint-3
			the place			

## 8.2 User Acceptance Testing

USER TYPE	FUNCTIONAL REQUIREMENT	USER STORY NUMBER	USER STORY/TASK	ACCEPTANCE CRITERIA	PRIORITY	Status
Customer(Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password	I can access my account/dashboard	High	Success
			As a user, I	I can		

		USN-2	will receive confirmation email once I have registered for the application	receive i confirmation & email click confirm	High	Success
--	--	-------	--	--	------	---------



		USN-3	As a user, I can register for the application through Gmail		Medium	Success
	Login	USN-4	As a user, I can log into the application email & password		High	Success
	Dashboard					
Customer (Web user)		USN-5	As a user, you can view edit your personal details	I can edit and view my details	Low	Success
		USN-6	As a user, you can determine future climatic changes	I can check on information about weather forecast	High	Success
Administrator		USN-7	As a admin you can	I can display	Medium	Success

			provide or display the requested details form user such as displaying forecasted weather of the place	forecasted details at weather.		
--	--	--	---	--------------------------------	--	--

## 9. Results

### 9.1 Performance metrics

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2
Sprint-1	Dashboard	USN-2	As a user, I will receive confirmation email once I have registered for the application	1
Sprint-2	Login	USN-3	As a user, I can register for the application through Facebook	2
Sprint-1	Registration	USN-4	As a user, I can register for the application through Gmail	2

## **10. Advantages and Disadvantages**

### **Advantages**

We've got more than a century of detailed disaster data, tracking hurricane paths and earthquake intensities and even volcanic eruptions and the signs that lead up to those events. Artificial intelligence and machine learning can take this data, analyze it and use that information to predict when new disasters might occur.

These systems can "learn" to predict everything from earthquakes and volcanic eruptions to floods, hurricanes and tornadoes. Scientists already collect detailed data as these events occur. AI merely takes this information to the next level. With enough data, a predictive AI system can accurately forecast future events.

The applications for this technology are numerous. Google is working on an AI platform to predict the location and likelihood of floods in monsoon-prone India. From there, the system can warn those who might need to evacuate to higher ground.

### **DISADVANTAGES:**

In a disaster, you face the danger of death or physical injury. You may also lose your home, possessions, and community. Such stressors place you at risk for emotional and physical health problems. Stress reactions after a disaster look very much like the common reactions seen after any type of trauma.

The prediction may go wrong and waste lot of resources and time. It causes people to lose their physical potential.

## **11. Conclusion**

Many researchers have attempted to use different deep learning methods for detection of natural disasters. However, the detection of natural disasters by using deep learning techniques still faces various issues due to noise and serious class imbalance problems. To address these problems, we proposed a multilayered deep convolutional neural network for detection and intensity classification of natural disasters. The proposed method works in two blocks—one for detection of natural disaster occurrence and the second block is used to remove imbalanced class issues. The results were calculated as average statistical values: sensitivity, 97.54%; specificity, 98.22%; accuracy rate, 99.92%; precision, 97.79%; and F1-score, 97.97% for the proposed model. The proposed model achieved the highest accuracy as compared to other state-of-the-art methods due to its multilayered structure. The proposed model performs significantly better for natural disaster detection and classification, but in the future the model can be used for various natural disaster detection processes.

## **12. Future Scope**

The prediction accuracy can increase. The model can use another set of layers to avoid distortion of images. The disaster will be more quickly and more widely televised via emergent and emerging social media, especially crowdsourcing technologies. As broadband cellular technologies reach the underdeveloped regions of the world, such disasters will be broadcast in significantly greater living color.

The public outcry from millennials, Hollywood, and eventually mainstream America, will crescendo. Funding will likely be quick and significant.

## **13. APPENDIX**

### **Building and training model**

```
from google.colab import drive
drive.mount('/content/drive')
import numpy as np
import pandas as pd
import tensorflow
```

```

as tf from tensorflow.keras import layers from tensorflow.keras.models import Sequential from
tensorflow.keras.preprocessing.image import ImageDataGenerator import matplotlib.pyplot as plt

train_datagon=ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_r
ange=0.2,horizontal_flip=True) test_datagon=ImageDataGenerator(rescale=1./255)

x_train=train_datagon.flow_from_directory('/content/drive/MyDrive/IBM- PROJECT/dataset/
train_set',target_size=(64,64),batch_size=5,color_mode='rgb',class_mode='categorical')
x_test=test_datagon.flow_from_directory('/content/drive/MyDrive/IBM- PROJECT/dataset/
train_set',target_size=(64,64),batch_size=5,color_mode='rgb',class_mode='categorical')

from tensorflow.keras.layers import Dense,Flatten from
tensorflow.keras.layers import Conv2D,MaxPooling2D

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.summary()

model.compile(optimizer='adam',loss='categorical_crossentropy',metrics
=['accuracy'])
model.save('disaster.h5') model_json=model.to_json()with open("model-bw.json","w")asjson_file:
json_file.write(model_json)

from tensorflow.keras.models import load_model from tensorflow.keras.preprocessing import
image model=load_model("disaster.h5")
img=image.load_img('/content/drive/MyDrive/dataset/test_set/
Earthquake/1321.jpg',target_size=(64,64)) x=image.img_to_array(img)
x=np.expand_dims(x,axis=0) pred=model.predict(x)np.argmax(pre d) pred
index=['Cyclone','Earthquake','Flood','Wildfire'] y=np.argmax(model.predict(x),axis=1)

print(index[int(y)])

```

home.html

```

<html>
  <head><title>homepage</title>
  <style>

```

```

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    dimgray; justify-content:
    center; align-items:
    center; height:
    100%;
    display: flex;
}
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{
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    color: chartreuse; width:
    100%; height:
    40px;
}
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{
    display: flex;    justify-
    content: flex-end; align-
    content: spacebetween;
    list-style: none; margin-
    top: -10px;
}
.navbar label
{
    font-size: 25px;
    margin-left:
    40px; font-
    weight: bold;
} ul
li
{
    width: 15%;
    font-size: 20px;
    font-weight:
    bold;
    margin-top: -
    10px;
    font-family: Cambria, Cochin, Georgia, Times, 'Times New Roman', serif;
}

```

li a

```
{
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}
a:hover
{
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    border-radius: 5px;
}
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    height:80%;
    margin:40px 50px;
    display: flex;
}
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{
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    height: 400px;
    margin-left:
    15px; box-
    shadow:-1px 0
    10px
    whitesmoke;
    align-items:
    center;
    justify-content: center;
    text-align:
    center;
}
img{ width:
    250px;
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    200px;
}
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{    text-align:
    center; color:
```

```

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  }
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    color:
    whitesmoke; font-
    size:
    15px;

}
</style>
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        <label>AI BasedNatural-Disaster-Analysis</label> <ul>

            <li><a href="">Home</a></li>
            <li><a href="">Introduction</a></li>
            <li><a href="">Open Web Cam</a></li>

        </ul>

    </nav>
    <div class="Main">
        <div class="container">
            <div class="disaster"><img
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```



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**Wildfire** Wildfires occur when vegetated areas are set alight and are particularly common during hot and dry periods. They can occur in forests, grasslands, brush and deserts, and with sufficient wind can rapidly spread.

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vrHm5mBAm1ufzx1lOK1NZksSZmEDTymUGGMmiHFMZcYerTbWlOmYs0AzHLzWt2jlhYvE  
lcfxHKMIiJ09zH/eHlKvWeW8IMv+5gfXS4InfbEj5ekR/FRBzJPljt5b+5GKrLkLoTvSdRqao3Sb  
mRyIPT2xEmaq7U6bNP3mlv3JQR85w+VQoUU9ABaB/BBF+QDxyvAGJ04c2oNrljVQKeosur6  
41aNKJletUgtFMRAgmDG1wN+8YNoVQZVp9QI9bgXnHecAVjemJ2j4j2vbryxwa9QyyUmVQ0jy  
yTb+nb364ltdMWn2idwglKamPYEx8gD7Y4zJDwS0RyA/HviZs4VQGooAeTCnzAWE+  
XmCRII54WvwphEnUqk2loAnb4ZI636dcVkiUmHZeuoGoqTA5ASZi9o/AYgzmf0lTpAkWNgB  
9bm+Bv8tpUwdLgnbzOzz2AWI9b4X5nOUqekMBqBkIYUKRbeNU97D64H8IIVC2OGzyc1JP  
Pzp+uMwoo/aynG2xi+7yJGMwfd+D9TBc5WNSiplhWp1NNjYAGRzggnOfdPL0yTJdyN5Ox

jqp1GZB2P1wd/lTmJWjs03AWQR8iBjMJztDg4z5IzmShAY+TmTcj5BT74npVSDu0GIOOsI6hW  
25c8ZjMV2HQQxqRgQxk9ACP2ffEb8MpsLF7/1Eb+hxMMwsEDJwgo2sBuk+ITtvY29LYlogBg  
CgmCBcdjItb3PPGYzEoWCNwSm5LFZ67ev7tgpch4agILDaGM39f1xmMwmZsUqatrNIByN  
5v3kj22wHnMnTqQoFQcvKywPmJj0+WMMxmKJMyvCKVOoHllksCWLXAubqLwf0xLn+LzAj0  
P0xmMxw+Q6xBa1Ak6iFgg3HxCBfe3UThGv2kdnKh2QAbBFMCLbm5kY3jMeaWmeiG1s3k  
/tM6qTCET8Wk89wRy25SO2I8/wDauspKMiQf6QRHQj0lXrGYq21syirJp105ojQDeoJMbb  
CZ hT0A6YS5vhDsGc1Cp5R6d5t2xmMx6IpNHC3YoX7NMw1Gqb/0j9caxmMxNIq2f//Z"><d  
iv class="title">Flood<P>Floods are the most frequent type of natural disaster and occur when an  
overflow of water submerges land that is usually dry. Floods are often caused by heavy rainfall,  
rapid snowmelt or a storm surge from a tropical cyclone or tsunami in coastal areas.

<div class="disaster"><div  
class="title">Earthquake<P>An earthquake is a phenomenon that occurs without warning and  
involves violent shaking of the ground and everything over it. It results from the release of  
accumulated stress of the moving lithospheric or crustal plates.</P></div></div>  
</div>  
</div>  
</body>  
</html>

intro.html

```
<html>
  <head><title>homepage</title>
  <style>
    .Main{ background-color:darkcyan;
      justify-content: center; align-
        items: center;
      height: 100%;
      display:flex;
    }
    .navbar
    {
      background-color:darkgrey;
      color:black; width:
        100%;
      height: 40px;
    }
  }
```

```

.navbarul
{
    display:flex; justify-content:flex-end;
    align-content: space-between;
    list-style: none; margin-top: -
    10px;
}
.navbarlabel
{
    font-size: 25px; margin-left:
    40px;
    font-weight: bold;
} ul
li
{
    width: 15%; font-
    size: 20px; font-
    weight: bold;
    margin-top:-10px;
    font-family: Cambria,Cochin, Georgia, Times,'Times New Roman',serif;
}
li a
{
    text-decoration: none;
    color:whitesmoke;
}
a:hover
{
    background-color:darkcyan;

    border-radius: 5px;
}
.Main
{
    text-align: center; color:wheat;
    font-family:'Segoe UI', Tahoma, Geneva, Verdana,sans-serif; font-size:
    12px;
}

```



```

</style>
</head>
<body>
  <navclass="navbar">
    <label>AI BasedNatural-Disaster-Analysis</label> <ul>

      <li><a href="C:/Users/DELL/IBM-PROJECT/flask/template/home.html">Home</a></li>
      <li><a href="C:/Users/DELL/IBM-PROJECT/flask/template/intro.html">Introduction</a></li>
      <li><a href="openwebcam.html">Open Web Cam</a></li> </ul>

    </nav>
    <divclass="Main">
      <h1>
        <span> China, India and the United States </span> <span> are among the countries
of the world most </span> <span> affected by natural disasters. </span> <span> Natural
disastershave the potential to wreck and even end the livesof those people,</span> <span>who
stand in their way.</span> <span> However, whether or not you are likely to be
</span> <span> affected by a natural disaster greatly depends</span> <span> on where in the world
you live,</span>

        <span> The objective of </span> <span> the project is to</span> <span>human build a
</span> <span> web application </span> <span> to detectthe </span> <span> type of disaster
.</span> <span> The input </span> <span> is taken from the in built web cam,</span>
        <span> which in turn </span> <span> is </span> <span> given to the </span> <span>
<span>pre trained model .</span> <span> The model predicts the </span> <span> type of disaster
</span> <span> and displayed</span> <span> on UI.</span>

      </h1>
    </div>
  </body>
</html>

```

upload.html

```

<html>
  <head><title>homepage</title>
  <style>
    .Main{ background-color:azure;
      justify-content: center;

```

```

        align-items: center; height:
        100%;
        display: flex;
    }
    .navbar
    {
        background-color: rgb(238, 81, 81); color: darkslategrey; width:
        100%;
        height: 40px;
    }
    .navbaryl
    {
        display: flex; justify-content: flex-end;
        align-content: space-between;
        list-style: none; margin-top: -
        10px;
    }
    .navbarylal
    {
        font-size: 25px; margin-left:
        40px; font-weight: bold;
    } ul
    li
    {
        width: 15%; font-
        size: 20px; font-
        weight: bold;
        margin-top: -10px;
        font-family: Cambria, Cochin, Georgia, Times, 'Times New Roman', serif;
    }
    li a
    {
        text-decoration: none; color: black;
    }
    a: hover
    {
        background-color: honeydew;

```

```

        border-radius: 5px;
    }
    .Main
    {
        text-align: center; color:wheat;
        font-family:'Segoe UI', Tahoma, Geneva, Verdana,sans-serif; font-size:
        12px;
    }
    img{
        height:80%; width:100%;
    }
</style>
</head>
<body>
    <navclass="navbar">
        <label>AI BasedNatural-Disaster-Analysis</label> <ul>

            <li><a
href="C:/Users/MAHALAKSHMI%20G/Downloads/buildhtml/home.html">Home</a></li>
            <li><a
href="C:/Users/MAHALAKSHMI%20G/Downloads/buildhtml/intro.html">Introduction</a></li>
            <li><a
href="C:/Users/MAHALAKSHMI%20G/Downloads/buildhtml/openwebcam.html">Open Web
Cam</a></li>
        </ul>
    </nav>
    <divclass="Main">
        
        </div>
    </body>
</html>

```

## GitHub

<https://github.com/IBM-EPBL/IBM-Project-27247-1660051833>

## **Project Demo Link**

<https://drive.google.com/file/d/1s9C8c2AqfvuPrV3NUS7huvQaH-WYPTXf/view?usp=sharing>