

## PROJECT REPORT

# Natural Disasters Intensity Analysis and Classification using Artificial Intelligence

*submitted by*

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# TABLE OF CONTENTS

1. INTRODUCTION	4
a. PROJECT OVERVIEW	
b. PURPOSE	
2. LITERATURE SURVEY	5
a. EXISTING PROBLEM	
b. REFERENCES	
c. PROBLEM STATEMENT DEFINITION	
3. IDEATION AND PROPOSED SOLUTION	7
a. EMPATHY MAP CANVAS	
b. IDEATION & BRAINSTORMING	
c. PROPOSED SOLUTION	
d. PROBLEM SOLUTION FIT	
4. REQUIREMENT ANALYSIS	11
a. FUNCTIONAL REQUIREMENTS	
b. NON FUNCTIONAL REQUIREMENTS	
5. PROJECT DESIGN	14
a. DATA FLOW DIAGRAM	
b. SOLUTION & TECHNICAL ARCHITECTURE	

c. USER STORIES	
6. PROJECT PLANNING AND SCHEDULING	18
a. SPRINT PLANNING AND ESTIMATION	
b. SPRINT DELIVERY SCHEDULE	
7. CODING & SOLUTIONING	20
8. TESTING	22
a. TEST CASES	
b. USER ACCEPTANCE TESTING	
i. DEFECT ANALYSIS	
ii. TEST CASE ANALYSIS	
9. RESULTS	25
a. PERFORMANCE METRICS	
10. ADVANTAGES & DISADVANTAGES	26
a. ADVANTAGES	
b. DISADVANTAGES	
11. CONCLUSION	27
12. FUTURE SCOPE	28
<b>APPENDIX</b>	<b>29</b>
SOURCE CODE	
GITHUB	
PROJECT DEMO	

# CHAPTER 1

## INTRODUCTION

### 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 developed a multilayered deep convolutional neural network model that classifies the natural disaster and tells the intensity of disaster of natural. The model uses an integrated webcam to capture the video frame and the video frame is compared with the Pre-trained model and the type of disaster is identified and showcased on the OpenCV window.

### PURPOSE

Disaster management plays an integral role in **keeping communities safe**. It involves coordinating the resources, such as pollution control systems, and responsibilities, such as following best practice policies, needed to prevent, prepare for, respond to, and recover from emergencies. Natural disasters generally constitute an emergency since they require immediate intervention due to their **high impact on human health and safety**; they affect the normal functioning of working infrastructure, interrupting normal day activities and representing a risk for residents and workers in affected areas.

# CHAPTER2

## LITERATURE SURVEY

### EXISTING PROBLEM

Many researchers have attempted to use different deep learning methods for detection of natural disasters. However, the detection of natural disasters by using deeplearning 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 occurrenceand 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.

### REFERENCES

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## **PROBLEM STATEMENT DEFINITION**

"IMD (Indian Meteorology department) is responsible to issue warnings for the rainfall and CWC (Central Water Commission) keeps a record of water reservoirs, however there is a lack of collation of data issued from both these departments. This prevents us from determining the impact/seriousness and due to which there are timeswhere adequate forewarnings are not provided. There are several High rainfall areas, low lying areas or flood prone areas. Currently there are limitations that these areas cannot be alerted before the critical situation because of the data unavailability or unavailability of simulation models which can calculate and predict the data. There is a requirement of data on the area likely to be inundated(depth) by release of water from reservoirs. 3D models may help in calculation of such data.a) Adequate forewarning forthe area where floods are likely to occur. b) Low lying areas may be alerted about the release of accurate quantity of water from the reservoirs and thus evacuation/shifting ofthe people can be planned. c) It will help the Response forces to deploy their resourcesaccordingly d) Prediction of release of water based on rainfall in catchment area and dissemination of an information to the affected public through mobile and other mediums."

# CHAPTER 3

## IDEATION AND PROPOSED SOLUTION

### EMPATHY MAP CANVAS



# IDEATION & BRAINSTORMING

## Brainstorm & idea prioritization

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.

10 minutes to prepare  
1 hour to collaborate  
3-8 people recommended

[Share template feedback](#)

**Before you collaborate**

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

- Team gathering: Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- Set the goal: Think about the problem you'll be focusing on solving in the brainstorming session.
- Learn how to use the facilitation tools: Use the Facilitation Experiences to run a happy and productive session.

[Open article](#)

**Define your problem statement**

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

How might we [your problem statement]?

**Key rules of brainstorming**

To use an anchor and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- One idea at a time.
- Go for volume.
- If possible, be visual.

**Brainstorm**

Write down any ideas that come to mind that address your problem statement.

10 minutes

**Subcategory T**

Danger zone classification

Build feedback system for early plan

Build feedback system for early plan

Improve early warning system

Improve early warning system

Improve early warning system

Improve early warning system

**Subcategory B**

Developing an app for disaster

Developing an app for disaster

Developing an app for disaster

Developing an app for disaster

Developing an app for disaster

Developing an app for disaster

Developing an app for disaster

Developing an app for disaster

**Group ideas**

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

10 minutes

Developing an AI model for Classification of Disaster

Developing an app for Detection

Analysis of previous Disaster

Improve Early warning and response system

Danger zone classification and evaluation of safer zone

Development of insurance policies and plans

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**Prioritize**

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

10 minutes

Importance

Feasibility

Developing an AI model for Classification of Disaster

Developing an app for Detection

Analysis of previous Disaster

Improve Early warning and response system

Danger zone classification and evaluation of safer zone

Development of insurance policies and plans

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**After you collaborate**

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

[Quick add-ons](#)

- Share the mural**  
Share a new link to the mural with collaborators to keep them in the loop about the outcomes of the session.
- Export the mural**  
Export a copy of the mural as a PDF or PNG to attach to emails, include in slides, or save to your drive.

**Keep moving forward**

- Strategy Workshop**  
Cluster the components of a new idea or strategy.
- Customer experience journey map**  
Visualize customer needs, motivations, and attitudes for an experience.
- Strengths, weaknesses, opportunities & threats**  
Analyze strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

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## PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To classify the natural disaster and the effect based on the webcam image given as input using Artificial Intelligence.
2.	Idea / Solution description	The classification is done by deep learning techniques such as Convolutional Neural Network (CNN) and Machine Learning Techniques.
3.	Novelty / Uniqueness	It is based on the satellite and multispectral image and the classification using Multilayered Deep Convolutional Neural Networks.
4.	Social Impact / Customer Satisfaction	The people can easily identify the type of natural disaster and its effect on the environment which leads to the earlier identification and reduced damage in the ecosystem.
5.	Business Model (Revenue Model)	We build a system that classifies the natural diasater and its intensity and it is believed that the website is useful for all people and also the website works for a long time effectively.
6.	Scalability of the Solution	The website will be made available for all the people who needs to classify the type of natural disaster. The machine learning and deep learning algorithms that are being used made it easier for the classification and intensity analysis.

# PROBLEM SOLUTION FIT

Define CS, fit into CC	<b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span> The global GIS in disaster management market size stood at \$2.3 billion in 2019, and it is expected to reach \$9.4 billion by 2030, exhibiting a CAGR of 13.7% during the forecast period (2020-2030). The major factors supporting the growth of the industry include the surging number of natural disasters, strong focus of government and emergency management organizations on adopting advanced GIS solutions, high need for analyzing geospatial data, and increasing public awareness about reducing the socioeconomic impact of natural disasters.	<b>6. CUSTOMER CONSTRAINTS</b> <span>CC</span> Awareness, education, preparedness, and prediction and warning systems can reduce the disruptive impacts of a natural disaster on communities. Mitigation measures such as adoption of zoning, land-use practices, and building codes are needed, however, to prevent or reduce actual damage from hazards.	<b>5. AVAILABLE SOLUTIONS</b> <span>AS</span> Planning to warn the people which will minimize the effects of disasters. Recovery and reconstruction.	Explore AS, differentiate
	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span> Natural disasters can cause great damage on the environment, property, wildlife and human health. These events may include earthquakes, floods, hurricanes, tornadoes, tsunamis, landslides, wildfires, volcanic eruptions, extreme temperatures. Property damage. Structural damage to buildings. Loss of utilities like electricity and water.	<b>9. PROBLEM ROOT CAUSE</b> <span>RC</span> The lack of resources and capacities (e.g., financial, human and technical) and a low level of knowledge and education emerged in all case studies as major root causes for several drivers of disaster risk.	<b>7. BEHAVIOUR</b> <span>BE</span> Analysis of public behavior plays an important role in crisis management, disaster response, and evacuation planning. Unfortunately, collecting relevant data can be costly and finding meaningful information for analysis is challenging. A growing number of Location-based Social Network services provides time-stamped, geo-located data that opens new opportunities and solutions to a wide range of challenges.	
Focus on J&P, fit into BE, understand RC	<b>3. TRIGGERS</b> <span>TR</span> Large economic losses, reduced accumulation of capital and infrastructure, long recovery period after disasters.	<b>10. YOUR SOLUTION</b> <span>SL</span> Natural disasters cannot be prevented but they can be detected. We can measure disaster risk by analyzing trends of, for instance, previous disaster losses. These trends can help us to gauge whether disaster risk reduction is being effective. We can also estimate future losses by conducting a risk assessment.	<b>8. CHANNELS of BEHAVIOUR</b> <span>CH</span> <b>8.1 ONLINE</b> We demonstrate how to improve investigation by analyzing the extracted public behavior responses from social media before, during and after natural disasters, such as hurricanes and tornadoes. <b>8.2 OFFLINE</b> Dissemination of information from nearby Government agencies and NGO'S.	Identify strong TR & EM
	<b>4. EMOTIONS: BEFORE / AFTER</b> <span>EM</span> Before the disaster, a positive association was found between place-identity and wellbeing, indicating that the stronger emotions participants evolved to the place, as well as remembered more and thought about the place, the stronger wellbeing they experienced at the site. After the disaster, the strength of this relationship decreased more than twice, accounted for by the weakening of the emotion-wellbeing link.			

# CHAPTER 4

## REQUIREMENT ANALYSIS

### FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement(Epic)	Sub Requirement (Story / Sub-Task)
FR - 1	User Registration	<ol style="list-style-type: none"> <li>1. Registering via Google Accounts</li> <li>2. Registering via Product's own user managementsystem</li> </ol>
FR - 2	User Authentication	<ol style="list-style-type: none"> <li>1. Verification through OTP</li> <li>2. Verification through EmailLink</li> </ol>

FR - 3	Designation of Region	<ol style="list-style-type: none"> <li>1. Ease of selection of necessary areasto bemonitored</li> <li>2. Versatile and Flexible operations on designatareas</li> </ol>
FR - 4	Analysis of Required Phenomenon	<ol style="list-style-type: none"> <li>1. Simple and easy analysis on thespecificphenomenon to be observed</li> </ol>
FR - 5	Accumulation of required Data	<ol style="list-style-type: none"> <li>1. Fast and Efficient data gathering capabilities regarding past eventanalysis and futureprediction</li> </ol>
FR - 6	Organizing Unstructured data	<ol style="list-style-type: none"> <li>1. Processing of raw and clustered data into clearandrefined data which is useful for analysis and prediction tasks</li> </ol>

FR - 7	Algorithm selection	<ol style="list-style-type: none"> <li>1. The freedom to choose from several classes of algorithm to be used in the process</li> <li>2. Customization of algorithm to suit the needs of a specific purpose</li> </ol>
FR - 8	Prediction and analysis of data	<ol style="list-style-type: none"> <li>1. Accurate results of the analysis provided by the process</li> <li>2. Advanced visualization techniques to help visualize the processed data for effective observation</li> </ol>
FR - 9	Report generation	<ol style="list-style-type: none"> <li>1. Restructuring of obtained results into clear and detailed report for future studies</li> </ol>

## NON-FUNCTIONAL REQUIREMENTS

<b>NFR No.</b>	<b>Non-Functional Requirement</b>	<b>Description</b>
NFR - 1	<b>Usability</b>	It is well suited for fields requiring diverse application of processes with efficiency, precision and ease.

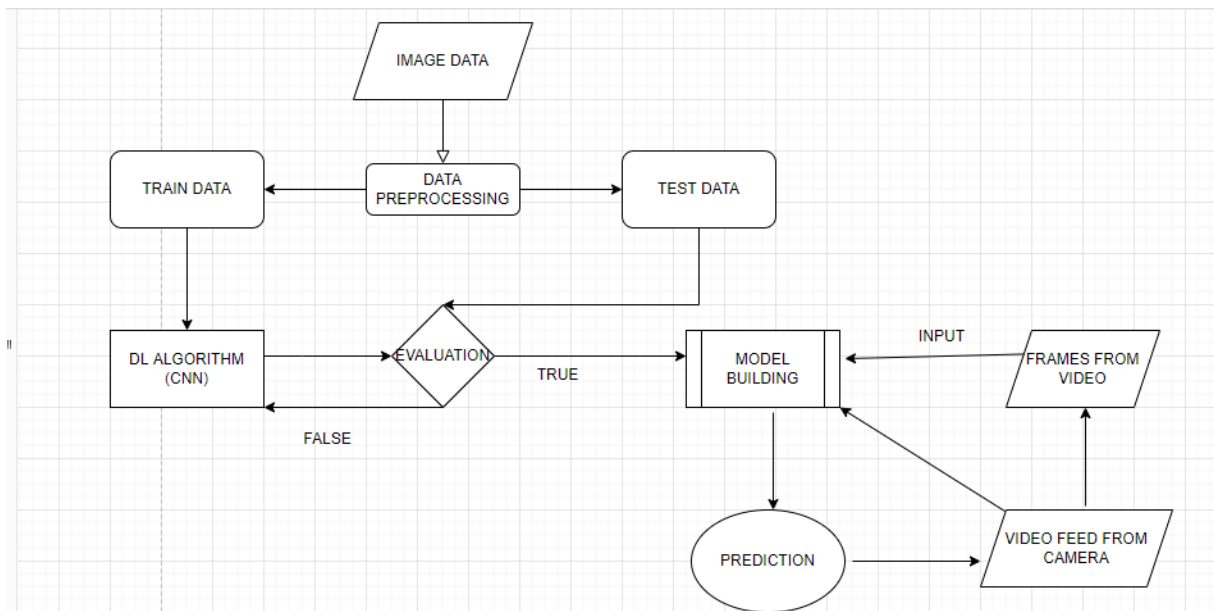
NFR - 2	<b>Security</b>	It provides a distinct and secure encryption layer to the system interface for additional security standards.
NFR - 3	<b>Reliability</b>	The product is robust and is capable of execution of processes even in the most difficult and unpredictable environments.
NFR - 4	<b>Performance</b>	The product boasts a high precision and efficient working capacity which helps in escalating its performance to the highest degree.
NFR - 5	<b>Availability</b>	Despite the complexity and degree of difficulty in its operation, the product is equipped with all-round maintenance and readily available technical services which provides the necessary support any individual requires in their duties.
NFR - 6	<b>Scalability</b>	The product also possess enough room for the improvement of its specifications to upgrade its capabilities according to the needs of the user and their organization

# CHAPTER 5

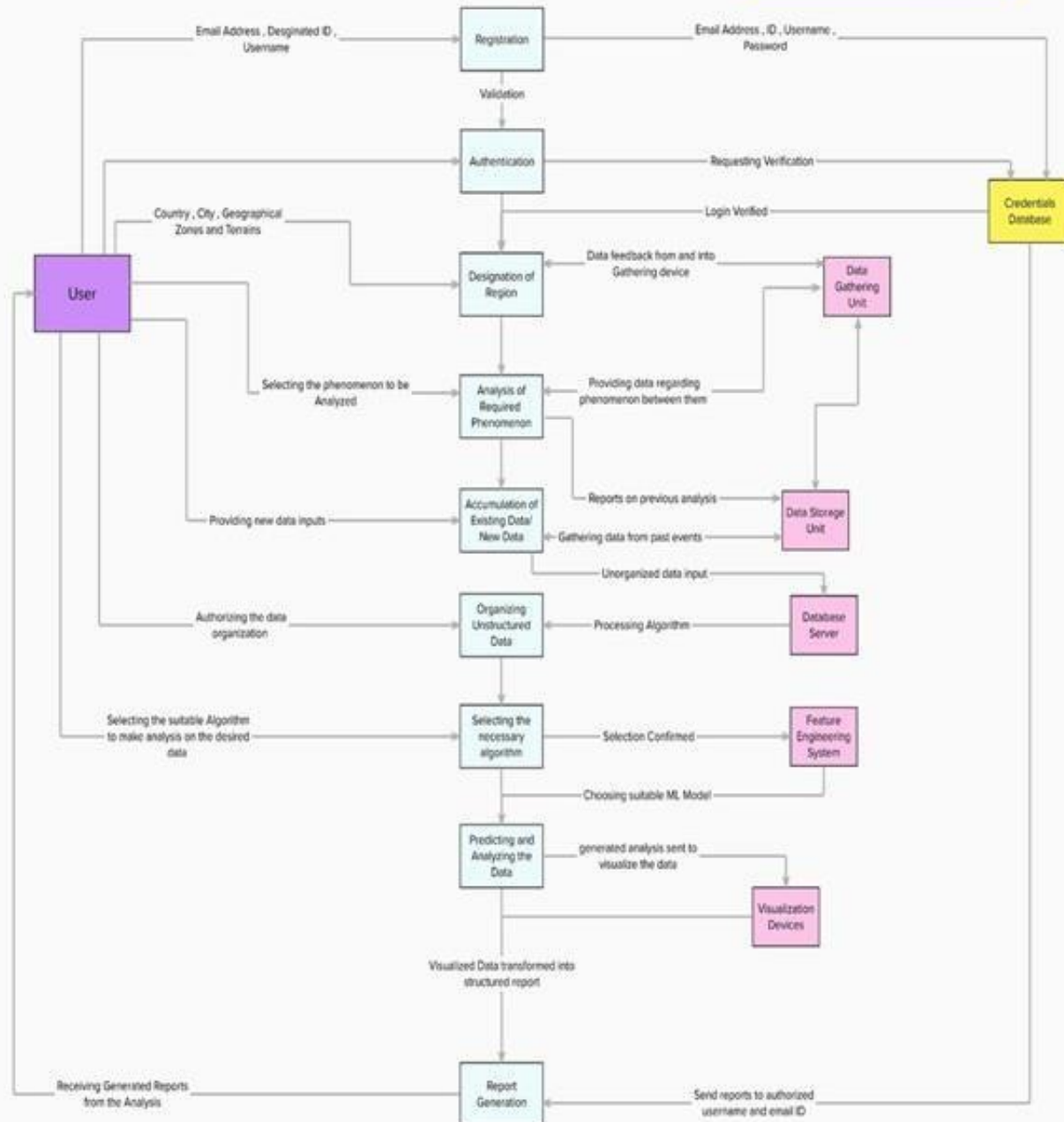
## PROJECT DESIGN

### 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 requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



PNT2022TMID48363



## USER STORIES

User Type	Functional Requirement (Epic)	User Story Number (USN)	User Story / Task	Acceptance criteria	Priority	Release
End user (Customer)	Registration	USN - 1	As a user, I am able to register with the Product using my valid email address	I should be able to register with my account credentials	High	Sprint - 1
End User (Customer)	Authentication	USN - 2	As a user, I am able to login into the system with my credentials	It should ensure smooth login capabilities without delay	High	Sprint - 1
End User (Customer)	Designation of Region	USN - 3	I can select the region of interest to be monitored and analyzed	I must be able to choose certain specific places without error	High	Sprint - 1
End User (Customer)	Analysis of Required Phenomenon	USN - 4	I am able to monitor certain factors that influence the actions of the phenomenon	It should consider and monitor most of the factors involved in the action	High	Sprint - 2
End User (Customer)	Accumulation of required Data	USN - 5	I am able to gather data regarding past events and a detailed report on past analysis	It should allow the storage of data of past events for certain extent	Medium	Sprint - 2
End User (Customer)	Organizing Unstructured data	USN - 6	I am able to organize and restructure the raw data into refined data	It should ensure easy and efficient processing methods	Low	Sprint - 3



End User (Customer)	Algorithm selection	USN - 7	I am able to choose the required Algorithm for a specific analysis	It must provide various options for the algorithm to be used	High	Sprint - 2
End User (Customer)	Prediction and analysis of data	USN - 8	I am able to easily predict and visualize the data	It should allow easy to use prediction and visualization techniques	High	Sprint - 3
End User (Customer)	Report generation	USN - 9	I am able to generate a clear and detailed report on the analysis	Report generation must be fast and efficient and should not be complex	Medium	Sprint - 4

# CHAPTER 6

## PROJECT PLANNING AND SCHEDULING

### SPRINT PLANNING AND ESTIMATION

<b>Sprint</b>	<b>Functional Requirement(Epic)</b>	<b>User story Number</b>	<b>User story / Task</b>	<b>Story points</b>	<b>Priority</b>	<b>Team members</b>
Sprint-1	Registration	USN – 1	As a user, Registering into the product using a valid email address	5	High	DEEPAK PANDIAN C
Sprint-2	Registration	USN – 2	As a user, Registering into the product using a valid username and password	3	Medium	ABIKISHORE P
Sprint-1	Authentication	USN – 3	As a user , I am able to log into the system with credentials	4	High	BALASUBRAMANIYAN M
Sprint-2	Authentication	USN - 4	As a user , I am able to log into the system with OTP	2	High	PIRUTHIVIRAJ R
Sprint-1	Designation of Region	USN – 5	selecting the region of interest to be monitored and analysed	3	High	DEEPAK PANDIAN C
Sprint-2	Analysis of Required Phenomenon	USN – 6	Regulating certain factors influencing the actions of the phenomenon	3	High	ABIKISHORE P
Sprint-2	Accumulation of required Data	USN – 7	Gathering data and detailed report on past event analysis	4	Medium	BALASUBRAMANIYAN M

Sprint-4	Organizing Unstructured data	USN – 8	Organizing and reorienting the raw data into a refined data	3	Low	PIRUTHIVIRAJ R
Sprint-2	Algorithm selection	USN – 9	Choosing a required algorithm for specific analysis	2	High	DEEPAK PANDIAN C
Sprint-3	Prediction and analysis of data	USN – 10	Predicting and visualizing the data effectively	6	High	ABIKISHORE P
Sprint-4	Report generation	USN – 11	Generating a clear and detailed report on product data analysis	3	High	BALASUBRAMANIYAN M

## SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	12	6 days	24 Oct 2022	29 Oct 2022	12	30 Oct 2022
Sprint-2	14	6 days	31 Oct 2022	5 Nov 2022	14	6 Nov 2022
Sprint-3	6	6 days	07 Nov 2022	12 Nov 2022	6	8 Nov 2022
Sprint-4	6	6 days	14 Nov 2022	19 Nov 2022	6	20 Nov 2022

# CHAPTER 7

## CODING & SOLUTIONING

### 7.1 FEATURE

```
from flask import Flask,render_template,request
import cv2
from tensorflow.keras.models import load_model
import numpy as np
from werkzeug.utils import secure_filename

app=Flask(__name__,template_folder="templates")
model=load_model('disaster.h5')
print("Loaded model from disk")

@app.route('/',methods=['GET'])
def home():
    return render_template("index.html")
@app.route('/home',methods=['GET'])
def back():
    return render_template("index.html")
@app.route('/upload',methods=['GET'])
def index():

    cap=cv2.VideoCapture(0)
    H=None
    W= None
```

```

while True:
    (grabbed,frame)= cap.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']

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

    print(result)
    return render_template("output.html",output=output)
    # cv2.putText(output,"activity:{}".format(result),(10,120),cv2.FONT_HERSHEY_PLAIN,1,(0,255,255),1 )
    # cv2.imshow("output",output)
    # if cv2.waitKey(2) & 0xFF==ord('x'):
    #     break
    # print("[info] cleaning up...")
    # cap.release()
    # cv2.destroyAllWindows()

```

```

    # return render_template("output.html",output=result)
if __name__=='__main__':
    app.run(host='0.0.0.0',port=8000,debug=False)

```

# CHAPTER 8

## TESTING

### TEST CASES

Test case ID	Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
HP_TC_001	UI	Home Page	Verify UI elements in the HomePage	The Home page must be displayed properly	Working as expected	PASS
HP_TC_002	UI	Home Page	Check if the UI elements are displayed properly in different screen sizes	The Home page must be displayed properly in all sizes	The UI is not displayed properly in screen size 2560 x 1801 and 768 x 630	FAIL
HP_TC_003	Functional	Home Page	Check if the page redirects to the result page once the input is given	The page should redirect to the results page	Working as expected	PASS
BE_TC_001	Functional	Backend	Check if all the routes are working properly	All the routes should properly work	Working as expected	PASS
M_TC_001	Functional	Model	Check if the model can handle various image	The model should rescale the image and predict the results	Working as expected	PASS
M_TC_002	Functional	Model	Check if the model predicts the disaster	The model should predict the disaster	Working as expected	PASS
M_TC_003	Functional	Model	Check if the model can handle complex input	The model should predict the disaster in the	The model fails to identify it since the model is not built to	FAIL

				compexfeed	handle such data	
RP_TC_001	UI	Result Page	Verify UI elements in the ResultPage	The Result page must be displayed properly	Working as expected	PASS
RP_TC_002	UI	Result Page	Check if the result is displayed properly	The result should be displayed properly	Working as expected	PASS
RP_TC_003	UI	Result Page	Check if the other predictions are displayed properly	The other predictions should be displayed properly	Working as expected	PASS

## 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
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## TEST CASE ANALYSIS

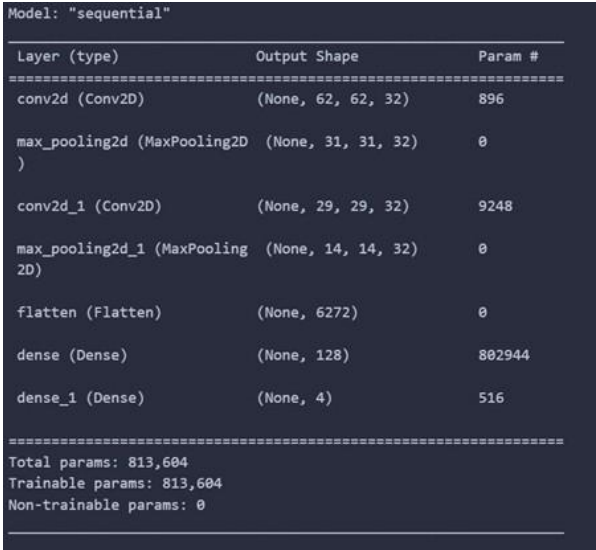
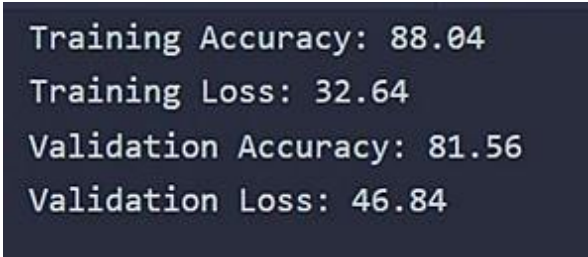
Section	Total Cases	Not Tested	Fail	Pass
Client Application	10	0	3	7
Security	2	0	1	1
Performance	3	0	1	2
Exception Reporting	2	0	0	2



# CHAPTER 9

## RESULTS

### 9.1 PERFORMANCE METRICS

S.No.	Parameter	Values	Screenshot
1.	Model Summary	-	 <pre> Model: "sequential" Layer (type)                Output Shape              Param # ----- conv2d (Conv2D)              (None, 62, 62, 32)       896 max_pooling2d (MaxPooling2D) (None, 31, 31, 32)       0 conv2d_1 (Conv2D)            (None, 29, 29, 32)       9248 max_pooling2d_1 (MaxPooling2D) (None, 14, 14, 32)       0 flatten (Flatten)            (None, 6272)              0 dense (Dense)                (None, 128)               802944 dense_1 (Dense)              (None, 4)                 516 ----- Total params: 813,604 Trainable params: 813,604 Non-trainable params: 0 </pre>
2.	Accuracy	Training Accuracy -88.04%  Validation Accuracy -81.56%	 <pre> Training Accuracy: 88.04 Training Loss: 32.64 Validation Accuracy: 81.56 Validation Loss: 46.84 </pre>

# **CHAPTER 10**

## **ADVANTAGES & DISADVANTAGES**

### **ADVANTAGES:-**

1. Humans also need breaks and time offs to balance their work life and personal life. But AI can work endlessly without breaks.
2. With the use of various AI-based techniques, we can also anticipate today's weather and the days ahead.
3. Helpful in getting life back on track..
4. Their Alert nature able to respond effectively and efficiently which defend the society from large scale damages.

### **DISADVANTAGES:-**

1. It involves huge money to be equipped.
2. Problems faced in life basic needs.
3. One application of artificial intelligence is a robot, which is displacing occupations and increasing unemployment .
4. Machines can perform only those tasks which they are designed or programmed to do, anything out of that they tend to crash or give irrelevant outputs which could be a major backdrop.

# CHAPTER 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.

# CHAPTER 12

## FUTURE SCOPE

AI -smart technology, which has enabled accurate and speedy solutions. If harnessed properly, the technology has the potential of predicting, preventing and providing response faster than ever.

AI data setups are trained to predict seismic data to analyze the patterns of earthquake occurrences, rainfall records and monitor flooding, measure the intensity of hurricanes and read the geological data to understand volcanic eruptions, such systems can reduce the catastrophic impact of natural disasters.

Last year, Google's Pilot project to monitor flood in India with the help of AI, was a successful one – it was a Patna project. They were able to predict floods and the regions that it would be affected due to the natural disaster with an accuracy of over 90%. It was possible owing to the combination of data from government agencies that provide on-ground information – from measuring devices placed on the spot and satellite captured images of flood-prone areas. They ran hundreds of thousands of simulations on its machine learning (ML) models to predict the flow of water. In the future, leveraging AI can help disaster management bodies install drones, sensors and robots to provide accurate information about damaged buildings and landscapes, potential floods, making rescue missions safer and less time-consuming.

There is a need for smart technology to be integrated within our local communities. Immediate response and tech-based solutions can help reduce the extent of damage. However, since AI is based on machine codes, there is a scope of limitations and errors. However, the amalgamation of human, empathy and alertness, could do wonders in the field of crisis management.

# APPENDIX

## SOURCE CODE

## MODEL CREATION

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

```
data_path = './Dataset/'
batch_size = 32
target_size = (64, 64)
```

```
train_datagen = ImageDataGenerator(rescale=1./255,
                                   shear_range=0.2,
                                   zoom_range=0.2,
                                   width_shift_range=0.1,
                                   height_shift_range=0.1,
                                   horizontal_flip=True,
                                   validation_split=0.2)

test_datagen = ImageDataGenerator(rescale=1. / 255, validation_split=0.2)
```

```
X_train = train_datagen.flow_from_directory(data_path,
                                             target_size=target_size,
                                             batch_size=batch_size,
                                             color_mode="rgb",
                                             subset="training",
                                             class_mode='categorical')
```

```
X_test = test_datagen.flow_from_directory(data_path,
                                           target_size=target_size,
                                           batch_size=batch_size,
                                           color_mode="rgb",
                                           subset="validation",
                                           class_mode='categorical')
```

```
Found 3544 images belonging to 4 classes.
Found 884 images belonging to 4 classes.
```

```
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: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 62, 62, 32)	896
max_pooling2d (MaxPooling2D)	(None, 31, 31, 32)	0

conv2d_1 (Conv2D)	(None, 29, 29, 32)	9248
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 32)	0
flatten (Flatten)	(None, 6272)	0
dense (Dense)	(None, 128)	802944
dense_1 (Dense)	(None, 4)	516

```

=====
Total params: 813,604
Trainable params: 813,604
Non-trainable params: 0

```

```

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

```

```

model.fit(X_train,
          steps_per_epoch=len(X_train),
          epochs=20,
          validation_data=X_test,
          validation_steps=len(X_test))

```

Output exceeds the [size limit](#). Open the full output data [in a text editor](#)

```

Epoch 1/20
111/111 [=====] - 63s 495ms/step - loss: 1.0808 - accuracy: 0.5282 - val_loss: 0.7762 - val_accuracy: 0.7025
Epoch 2/20
111/111 [=====] - 52s 470ms/step - loss: 0.7012 - accuracy: 0.7322 - val_loss: 0.7050 - val_accuracy: 0.7353
Epoch 3/20
111/111 [=====] - 50s 448ms/step - loss: 0.6575 - accuracy: 0.7525 - val_loss: 1.1470 - val_accuracy: 0.6210
Epoch 4/20
111/111 [=====] - 47s 428ms/step - loss: 0.5846 - accuracy: 0.7847 - val_loss: 0.8129 - val_accuracy: 0.6980
Epoch 5/20
111/111 [=====] - 49s 442ms/step - loss: 0.5523 - accuracy: 0.7999 - val_loss: 0.6012 - val_accuracy: 0.7760
Epoch 6/20
111/111 [=====] - 52s 470ms/step - loss: 0.5448 - accuracy: 0.7923 - val_loss: 0.7817 - val_accuracy: 0.7048
Epoch 7/20
111/111 [=====] - 46s 415ms/step - loss: 0.4935 - accuracy: 0.8149 - val_loss: 0.6035 - val_accuracy: 0.7602
Epoch 8/20
111/111 [=====] - 45s 406ms/step - loss: 0.4554 - accuracy: 0.8361 - val_loss: 0.5008 - val_accuracy: 0.8111

```

```

Epoch 9/20
111/111 [=====] - 45s 405ms/step - loss: 0.4598 - accuracy: 0.8335 - val_loss: 0.6498 - val_accuracy: 0.7557
Epoch 10/20
111/111 [=====] - 45s 403ms/step - loss: 0.4260 - accuracy: 0.8420 - val_loss: 0.7311 - val_accuracy: 0.7217
Epoch 11/20
111/111 [=====] - 45s 406ms/step - loss: 0.4475 - accuracy: 0.8352 - val_loss: 0.4500 - val_accuracy: 0.8224
Epoch 12/20
111/111 [=====] - 45s 403ms/step - loss: 0.4096 - accuracy: 0.8507 - val_loss: 0.5084 - val_accuracy: 0.7952
Epoch 13/20
...
Epoch 19/20
111/111 [=====] - 43s 387ms/step - loss: 0.3500 - accuracy: 0.8685 - val_loss: 0.4097 - val_accuracy: 0.8473
Epoch 20/20
111/111 [=====] - 44s 392ms/step - loss: 0.3264 - accuracy: 0.8804 - val_loss: 0.4684 - val_accuracy: 0.8156

<keras.callbacks.History at 0x19d4c8a69b0>

```

```

model.save("disaster.h5")

```

```

from tensorflow.keras.preprocessing import image
import matplotlib.pyplot as plt

def predict(image_path):
    img = image.load_img(image_path, target_size=target_size)
    x = image.img_to_array(img)
    x = np.expand_dims(x, axis=0)

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

    pred = model.predict(x)
    prediction = labels[np.argmax(pred[0])]

    print(f'Disaster: {prediction}')
    plt.imshow(plt.imread(image_path))
    plt.axis('off')
    plt.show()

```

```
predict('./Sample/1.jpg')
```

```
1/1 [=====] - 0s 26ms/step
```

```
Disaster: Wildfire
```





```
predict('./Sample/2.jpg')
```

1/1 [=====] - 0s 26ms/step

Disaster: Cyclone



```
predict('./Sample/3.jpg')
```

1/1 [=====] - 0s 31ms/step

Disaster: Earthquake



```
predict('./Sample/4.jpg')
```

```
1/1 [=====] - 0s 26ms/step
```

```
Disaster: Flood
```



## FLASK APP.PY

```
from flask import Flask,render_template,request
import cv2
from tensorflow.keras.models import load_model
import numpy as np
from werkzeug.utils import secure_filename

app=Flask(__name__,template_folder="templates")
model=load_model('disaster.h5')
print("Loaded model from disk")

@app.route('/',methods=['GET'])
def home():
    return render_template("index.html")
@app.route('/home',methods=['GET'])
def back():
    return render_template("index.html")
@app.route('/upload',methods=['GET'])
def index():

    cap=cv2.VideoCapture(0)
    H=None
    W= None
    while True:
        (grabbed,frame)= cap.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']

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

        print(result)
        return render_template("output.html",output=output)
        # cv2.putText(output,"activity:{}".format(result),(10,120),cv2.FONT_HERSHEY_PLAIN,1,(0,255,255),1 )
        # cv2.imshow("output",output)
        # if cv2.waitKey(2) & 0xFF==ord('x'):
        #     break
        # print("[info] cleaning up...")
        # cap.release()
        # cv2.destroyAllWindows()

        # return render_template("output.html",output=result)
if __name__=='__main__':
    app.run(host='0.0.0.0',port=8000,debug=False)

```

## INDEX . HTML

```

<html>
<head>
    <meta charset="utf-8" name="viewport" content="width=device-width, initial-scale=1.0">
    <style>
        *{
            margin: 0;
            padding: 0;
        }
        body{
            width: 100vw;
            height: 100vh;
        }
        .content{
            display: flex;
            flex-direction: column;
            margin-top: 5rem;
        }

        .top{
            height: 3rem;
            background-color: #0070c0;
            color: white;
            display: flex;
            letter-spacing: 2px;
            align-items: center;
            font-weight: 900;
            font-size: 1.2rem;

```

```

    font-family: monospace;
    padding-left: 2.5rem;
}
.images{
    display: flex;
    justify-content: center;
    align-items: center;
}
img{

    width:200px;
    height:300px ;
    border-radius: 1rem;
    margin-left: 5rem;
}
button{
    position: relative;
    background-color: #0070c0;
    color: white;
    padding: 5px 10px;
    border: 1px solid #0070c0;
    font-weight: 900;
    font-size: 1.2rem;
    font-family: monospace;
    display: flex;
    margin-left: 46%;
    margin-top: 5rem;
}

```

```

</style>
</head>
<body>

    <div class="top">
        <div id="heading">AI Based Natural Disaster Analysis </div>
    </div>
    <div class="content">
        <div class="images">
            
            
            
            
        </div>
        <form action="/upload" method="get">
            <button type="submit">Open Web Camera</button>
        </form>
    </div>

</body>
</html>

```

## OUTPUT .HTML

```
<html>
<head>
<style>
*{
padding: 0;
margin: 0;
}
body{
height: 100vh;
width: 100vw;
}

.top{
height: 3rem;
background-color: rgb(12, 104, 161);
color: white;
display: flex;
letter-spacing: 2px;
align-items: center;
font-weight: 900;
font-size: 1.2rem;
font-family: monospace;
padding-left: 2.5rem;
}
.top #home{
position: absolute;
background-color: rgb(12, 104, 161);
color: white;
```

```

right: 40;
padding: 2px 8px;
font-size: 1rem;
font-family: monospace;
border: 1px solid rgb(255, 255, 255);
border-radius: 5px;
}
.content{
display: flex;
justify-content: center;
}
#name{
padding: 3rem;
text-transform: uppercase;
font-size: 2rem;
font-weight: 900;
text-align: center;
font-family: 'Times New Roman', Times, serif;
}
img{
width: 400px;
height: 400px;
border-radius: 4rem;
}
```

```

    </style>
</head>
<body>

    <div class="top">
        <div id="heading">AI Based Natural Disaster Analysis </div>
        <form action="/home" method="get">
            <button type="submit" id="home">Home</button>
        </form>

    </div>

    <div id="name">{{output}}</div>
    <div class="content">
        

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

```



**GITHUB:-**

<https://github.com/IBM-EPBL/IBM-Project-43118-1660713051>



**PROJECT DEMO:-**

<https://drive.google.com/drive/u/0/folders/1LAotxdeamMHP26TVrhr5HdA6c-GBHdfqK>