



**MUTHAYAMMAL ENGINEERING COLLEGE**

(An Autonomous Institution)

(Approved by AICTE, Accredited by NAAC, NBA & Affiliated to Anna University)

**NATURAL DISASTER INTENSITY ANALYSIS**  
**AND CLASSIFICATION USING ARTIFICIAL**  
**INTELLIGENCE**

**Project Report**  
*Submitted by*

Eddagotti Anil raj (9985770378)

Lingireddy Mahanth Kumar reddy (8242527436)

Mangala Muni Vardhan (6309611043)

Madisetty Veera Bhaskar (9347868813)

**BACHELORS OF ENGINEERING**

**(IN)**

**COMPUTER SCIENCE & ENGINEERING**

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# **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. 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**

The purpose of this project is to detect the natural disaster and reduce, or avoid, the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery.

## **CHAPTER 2**

### **LITERATURE SURVEY**

**TITLE :** A Deep Learning Approach of Recognizing Natural Disasters on Images.

#### **PROPOSED WORK**

First, this work introduces to the research community a new dataset for the joint classification of natural disaster types and intensity. Moreover, this study primarily aims to explore natural disasters recognition using a convolutional neural network and transfer learning. An open source tool is used for finding and removing the repeated images for analysis. Wildfire, Earthquake, Flood and Volcanic eruption are taken. In particular, this study attempts to build and train a lightweight convolutional neural network that can jointly recognize natural disaster types and intensity. Based on the intensity, it classifies as Severe, Moderate, Insignificant Lastly, this study attempts to measure the model performance using four performance measures; accuracy, precision, recall, and F1-Score.

#### **TOOLS USED/ALGORITHM**

- Image Processing
- Slope NDVI
- Location API
- Cloud Architecture
- Google Earth Engine

- K-Means and Classification Algorithm
- RGB Scale

**TECHNOLOGY :** Artificial Intelligence

**TITLE :** Disaster Intensity-Based Selection of Training Samples for Remote Sensing Building Damage Classification.

## **PROPOSED WORK**

In this proposed work, two fully automatic procedures for the detection of severely damaged buildings are introduced. The fundamental assumption is that samples that are located in areas with low disaster intensity mainly represent non-damaged buildings. Furthermore, areas with moderate to strong disaster intensities likely contain damaged and nondamaged buildings. Under this assumption, a procedure that is based on the automatic selection of training samples for learning and calibrating the standard support vector machine classifier is utilized. The second procedure is based on the use of two regularization parameters to define the support vectors. These frameworks avoid the collection of labeled building samples via field surveys and/or visual inspection of optical images, which requires a significant amount of time. The performance of the proposed method is evaluated via application to three real cases. The resulted accuracy ranges between 0.85 and 0.89, and thus, it shows that the result can be used for the rapid allocation of affected buildings.

## **TOOLS USED/ALGORITHM**

- Automatic labelling

- Building damage
- Multi regularization parameters
- Demand Parameter
- Support Vector Machine (SVM)

**TECHNOLOGY :** Machine Learning

**TITLE :** Hurricane Damage Detection using Machine Learning and Deep Learning Techniques

## **PROPOSED WORK**

In this proposed work, Disaster detection can be done through social media and satellites. Images obtained from satellites are widely used since capturing and processing of these images can be done in a shorter span of time. Satellite images help to recognize damage pattern caused by the disasters. The images from social media are also useful since they provide information on an immediate basis. Since manual methods are error-prone, deep learning and machine learning are used which used for detecting the damage caused by disasters effectively.

## **TOOLS USED/ALGORITHM**

- Social-media
- Satellite imagery
- Deep learning techniques

- CNN,VGG-16, ResNet
- Machine learning techniques
- Support Vector Machine, Decision trees, random forest.

**TECHNOLOGY :** Machine Learning, Deep Learning

### **Existing Problem**

Earlier we focus on post disaster relief and rehabilitation measures. Now the focus is shifted. As per sec.2(e) of DM Act 2005, Disaster Management means a coordination and integrated process of planning, organizing, coordinating, and implementing measures which are necessary or expedient for-

- (i) Prevention of danger or threat of any disaster
- (ii) Preparedness to deal with any disaster
- (iii) Prompt response to any threatening disaster situation or disaster
- (iv) Assessing the severity or magnitude of effects of any disaster
- (v) Evacuation, rescue, and relief
- (vi) Rehabilitation and reconstruction



## References

1. Mignan, A.; Broccardo, M. Neural network applications in earthquake prediction (1994–2019): Meta-analytic and statistical insights on their limitations. *Seism. Res. Lett.* 2020, 91, 2330–2342. [CrossRef]
2. Tonini, M.; D’Andrea, M.; Biondi, G.; Degli Esposti, S.; Trucchia, A.; Fiorucci, P. A Machine Learning-Based Approach for Wildfire Susceptibility Mapping. The Case Study of the Liguria Region in Italy. *Geosciences* 2020, 10, 105. [CrossRef]
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4. Schlemper, J.; Caballero, J.; Hajnal, V.; Price, A.N.; Rueckert, D. A deep cascade of convolutional neural networks for dynamic MR image reconstruction. *IEEE Trans. Med. Imaging* 2017, 37, 491–503. [CrossRef] [PubMed]
5. Tang, C.; Zhu, Q.; Wu, W.; Huang, W.; Hong, C.; Niu, X. PLANET: Improved convolutional neural networks with image enhancement for image classification. *Math. Probl. Eng.* 2020, 2020. [CrossRef]

## **Problem Statement Definition**

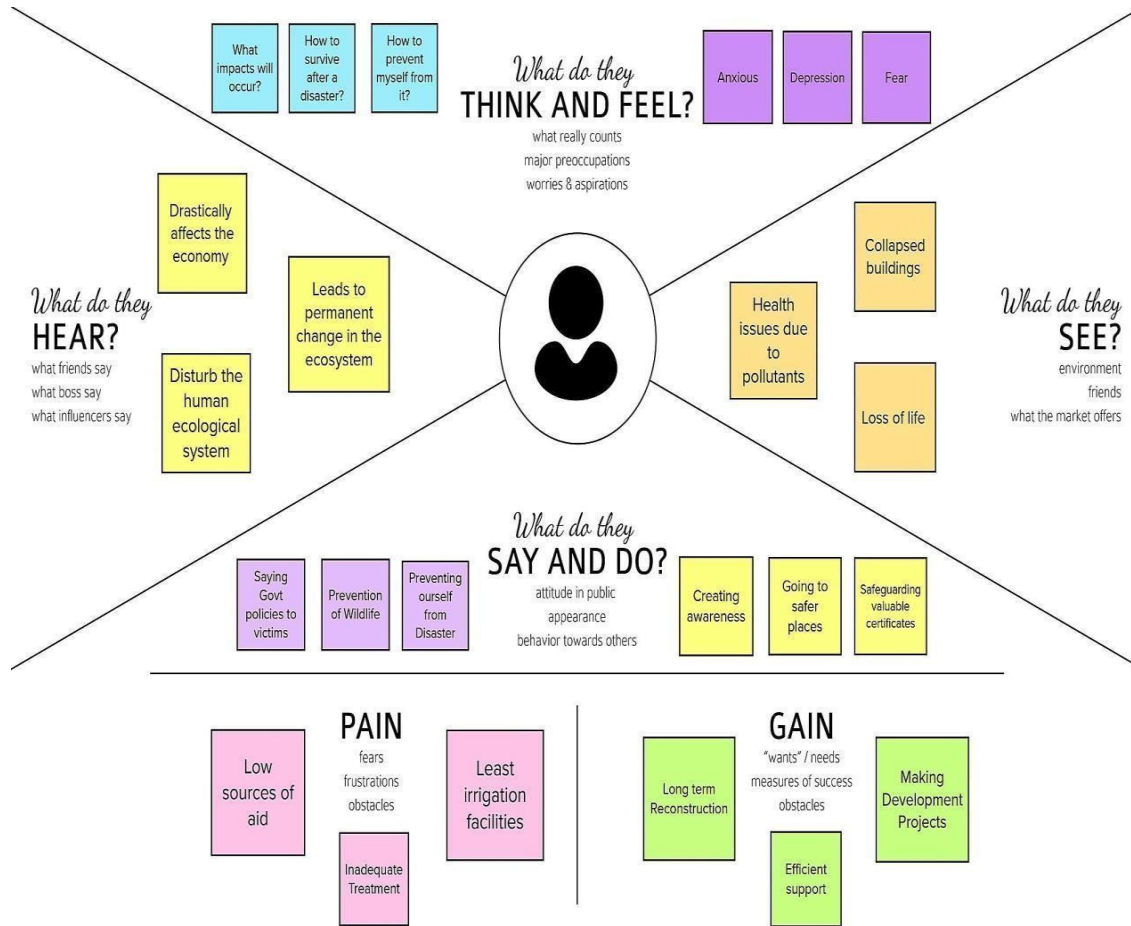
People need a way to classify and analyse the natural disaster so that they can prevent themselves from losses due to the disaster and millions of lives.

People and animals are facing so many issues like loss of life, property, resources and deterioration of the air quality due to the natural disaster. So we need to analyse and detect natural disaster and protect them from such disaster.

## CHAPTER 3


### IDEATION & PROPOSED SOLUTION

#### Empathy Map Canvas



# Ideation & Brainstorming

template




## 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
- 2-8 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

A

Team gathering

Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B

Set the goal


Think about the problem you'll be focusing on solving in the brainstorming session.

C

Learn how to use the facilitation tools

Use the Facilitation Superpowers 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







PROBLEM

How to classify and analyse the intensity of a natural disaster using artificial intelligence



### Key rules of brainstorming

To run a smooth and productive session

 Stay in topic.	 Encourage wild ideas.
 Defer judgement.	 Listen to others.
 Go for volume.	 If possible, be visual.

e

### Brainbvm

Wijte dawn any Ideas that corre to mind that addies • yois piobtem statement.

You can select a sticky note and hit the pencil button to

D

AI-based  
methods can be  
very effective if a  
training datBA  
covers very targe  
even is

To analyse  
the intent of  
disaster use  
CNN

. The proposed  
model should  
achieve high  
accuracy

Do a  
literature  
survey

To classify  
the disasters  
use ML  
models

Get insights  
from previous  
research  
works

Use CNNs  
they efficiently  
perform  
feature  
extraction

Using  
massive  
volumes of  
high quality  
dataset.

Infomiation from  
social media can  
be used as data  
sources to carry  
out disaster  
analysis

To prevent  
natural  
disasters in  
the future

so«al media is  
considered as a  
main source of  
big data

find out the victims  
of natural  
disasters using  
streaming

prepare an  
outline on  
how to  
approach the

Help the  
victims of  
natural

to predict  
future

take some action against heavy loss of human ecological  
disaster  
systems  
and  
problem  
disasters

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problem

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disaster

y  
disasters

systems and  
property



#### 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.

#### 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.

## Grouping bases on dataset

AI-based methods can be very effective if a training dataset covers very large  
even

Information from social media can be used as data sources to carry out disaster analysis

Using massive volumes of high quality dataset.

Social media is considered as a main source of big data

To analyse the intent of disaster use CNN

Using

## Grouping based on literature survey

Get insights from previous research

Do a literature survey

prepare an outline on how to approach the problem

Importance  
If each of those tasks could get done without any difficulty or cost, which would have the most positive impact?

high quality dataset.

prepare an outline on how to approach the problem

## Grouping based on models

To analyse the intent of disaster use CNN

find out the victims of natural disasters using streaming

---

## Proposed solution

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	People needs a way to classify and analyse the Disaster priorly so that they can protect themselves from losses due to the Disaster and Millions of Lives.,
2.	Idea/Solution description	This project uses Multi-layered Deep Convolutional Neural Network (pre-trained) model to classify Natural Disaster and calculate the intensity of the Disaster.
3.	Novelty/Uniqueness	To reduce the issues due to imbalance structure of images, the model uses an integrated webcam to capture the video frame and test data is compared with pretrained data.
4.	Social impact/Customer Satisfaction	By the Application, economic damage caused by Disaster can be reduced. Detection of Natural Disaster will become easier while using videos in Deep CNN instead of images.
5.	Business Model (Revenue Model)	Multi-layered Deep Convolutional Neural Network Model.
6.	Scalability of the Solution	Highly expandible, dependable, reliable, scalable and has robustness.





## CHAPTER 4

### REQUIREMENT ANALYSIS

#### Functional Requirement

<b>FR No.</b>	<b>Functional Requirement(Epic)</b>	<b>Sub Requirement (Story / Sub-Task)</b>
<b>FR-1</b>	Request Permission	Access permission from web camera.
<b>FR-2</b>	Disaster Detection	Based on the webcam image, natural disaster is classified.
<b>FR-3</b>	Accuracy	Since the training and testing images are huge, The accuracy is higher.
<b>FR-4</b>	Speed	The generation of results from the input Images are faster.
<b>FR-5</b>	Resolution	The resolution of the integrated web camera should be high enough to capturethe video frames.
<b>FR-6</b>	User Interface	Maximizing the interaction in Web Designing Service.

## Non-Functional Requirement

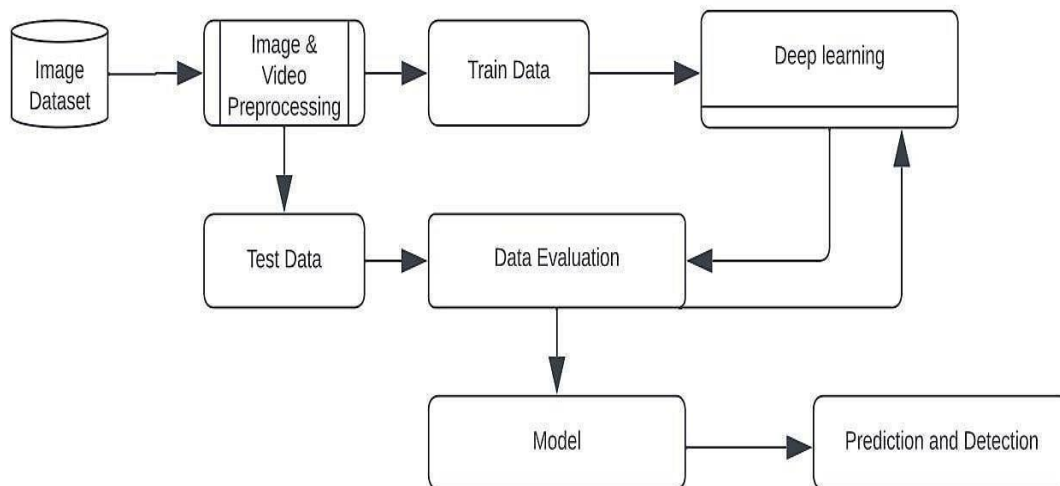
<b>NFR. No.</b>	<b>Non-Functional Requirement</b>	<b>Description</b>
<b>NFR-1</b>	Usability	User friendly and classify the disaster easily.
<b>NFR-2</b>	Security	The model is secure due to the cloud deployment models and also there is no login issue.
<b>NFR-3</b>	Reliability	Accurate prediction of the natural disaster and the website can also be fault tolerant.
<b>NFR-4</b>	Performance	It is shown that the model gives almost 95 Percent accuracy after continuous training.
<b>NFR-5</b>	Availability	The website will be made available for 24 hours.
<b>NFR-6</b>	Scalability	The website can run on web browsers like Googlechrome, Microsoft edge and also it can be extended to the NDRFand customers.

# CHAPTER 5

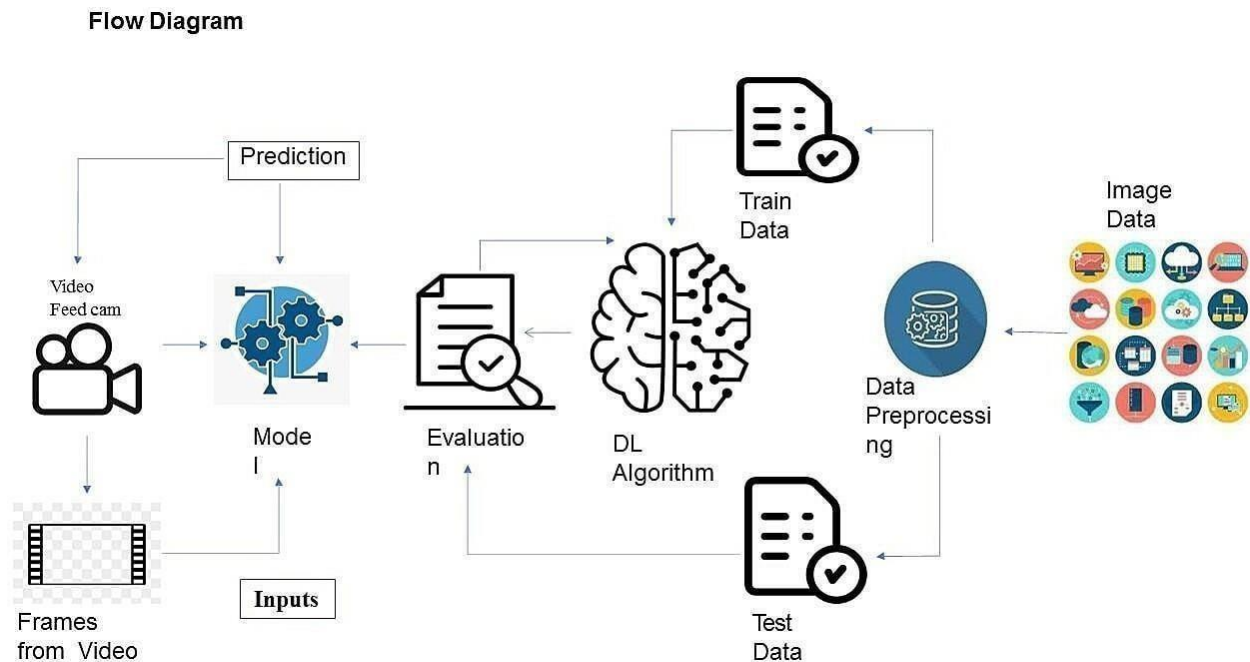
## PROJECT DESIGN

### Data Flow Diagrams

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 to be enter and leaves the system, what changes the information, and where data is stored.



## Flow Diagram



## Solution & Technical Architecture

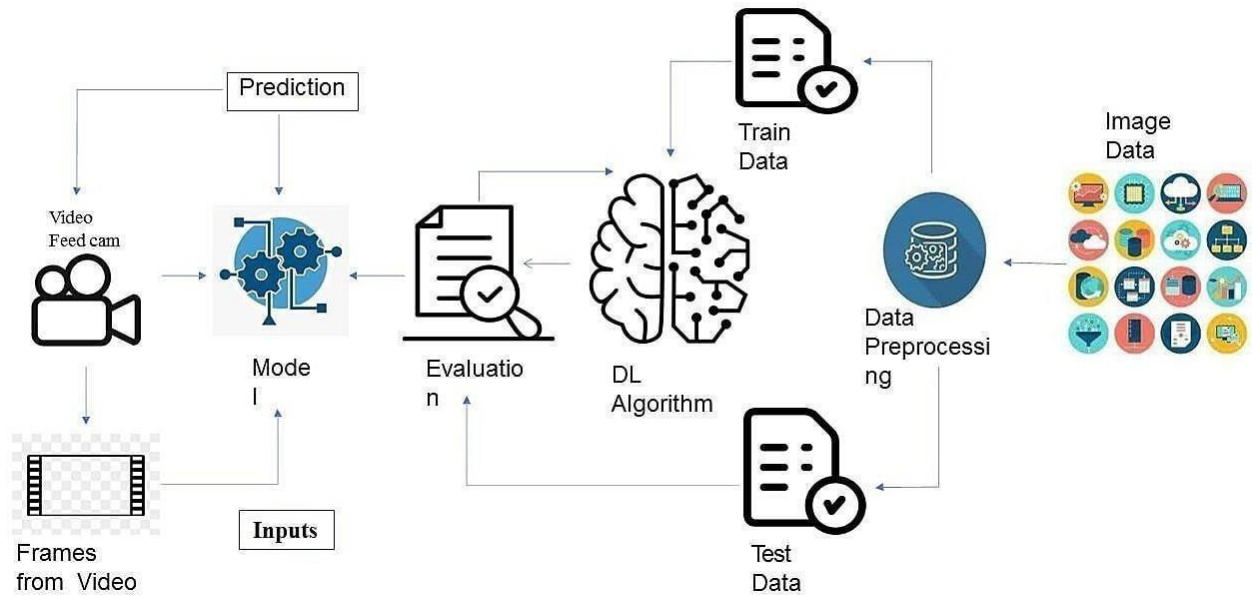
### Solution Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

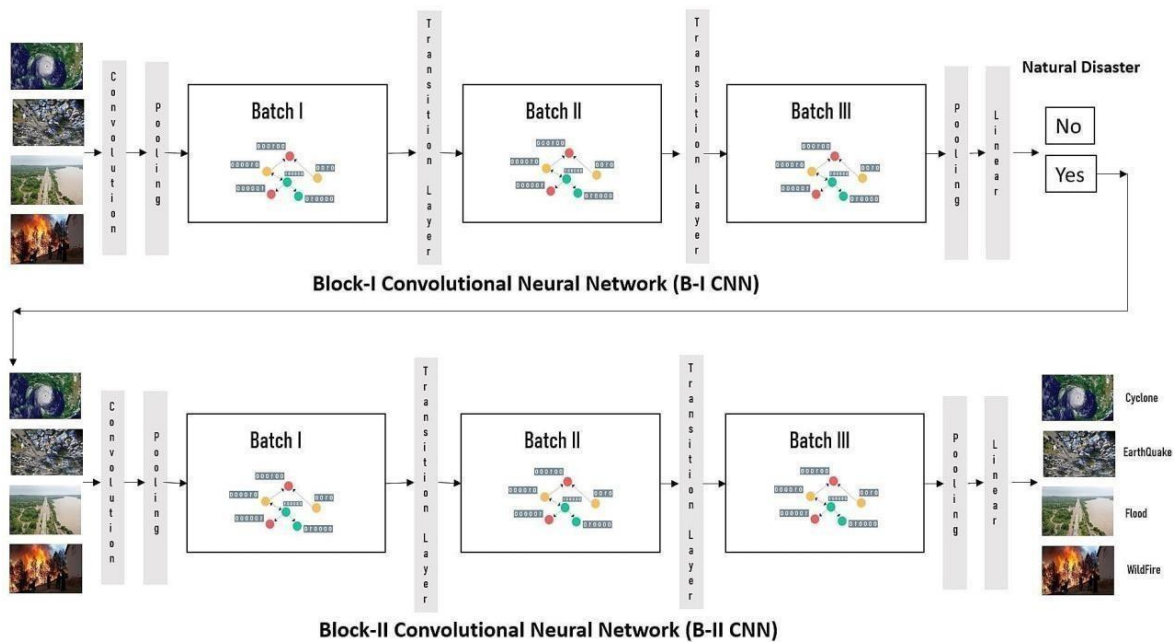
- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

## Solution Architecture Diagram

Flow Diagram



## Technical Architecture



### Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	User interacts with application for the detection of any Natural disaster's intensity and classify which happened just before.	HTML, CSS, JavaScript, Django, Python.
3.	Disaster Detection	This function is used to detect, Outcomes from the new trained data to perform new tasks and solve new problems.	Decision trees, Regression, Convolutional Neural networks.
4.	Evaluation system	It monitors that how Algorithm performs on data as well as during training.	Chi-Square, Confusion Matrix, etc.
5.	Input data	To interact with our model and give it problems to solve. Usually this takes the form of an API, a user interface, or a command-line interface.	Application programming interface, etc.

6.	Data collection unit	Data is only useful if it's accessible, so it needs to be stored ideally in a consistent structure and conveniently in one place.	IBM Cloud, SQL Server.
7.	Database management system	An organized collection of data stored in database, so that it can be easily accessed and managed.	MySQL, DynamoDB etc.

### **Application Characteristics:**

<b>S.No</b>	<b>Characteristics</b>	<b>Description</b>	<b>Technology</b>
1.	Open-Source Frameworks	An open source framework is a template for software development that is designed by a social network of software developers. These frameworks are free for public use and provide the foundation for building a software application.	Keras, Tensorflow.
2.	Authentication	This keeps our models secure and makes sure only those who have permission can use them.	Encryption and Decryption (OTP).



3.	Application interface	User uses mobile application and web application to interact with model	Web Development (HTML,CSS)
4.	Availability (both Online and Offline work)	Its include both online and offline work. As good internet connection is need for online work to explore the software perfectly. Offline work includes the saved data to explore for later time.	Caching, backend server.
5.	Regular Updates	The truly excellent software product needs a continuous process of improvements and updates. Maintain your server and make sure that your content is always up-to-date. Regularly update an app and enrich it with new features.	Waterfall Approach, Incremental Approach, Spiral Approach
6.	Personalization	Software has features like flexible fonts, backgrounds, settings, colour themes, etc. which make a software interface looks good and functional.	<ul style="list-style-type: none"> <li>• CSS</li> </ul>

## User Stories

Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria
Collection of dataset	USN-1	As a user, I can collect the dataset for monitoring and analyzing.	Enough data collected for training Model.
Home Page	USN-2	As a user, I want to know to about the basics of frequently occurring Disasters.	I can get the idea about the Application.
Intro page	USN-3	As a user, I want to about the introduction of Disaster in particular areas.	I can get idea about the disaster and where it occurs.
Open webcam	USN-4	As a user, I adapt with the webcam to analyze and classify the Disaster from video capturing	I can capture a video or image of particular disaster to analyze and classify.
Analysis of required phenomenon	USN-5	As a user, I can regulate certain factors influencing the action and report on past event analysis.	Model should be easy to use & working fine from the web app.

Algorithm selection	USN-6	As a user, I can choose the required algorithm for specific analysis.	Selection must give the better accuracy and better output.
Training and Testing	USN-7	As a user, I can train and test the model using the algorithm.	Training the model to classify and analyze the intensity
Detection and analysis of data	USN-8	As a user, I can detect and visualize the data effectively.	I can capture a video or image of particular disaster to analyze and detect.
Model building	USN-9	As a user I can build with the web application.	Model should be predicting occurrence of the disaster and intensity level of disaster.
Integrate the web app with the AI Model	USN-10	As a user, I can use Flask app to use model easily through web app.	Model should be easy to use and working fine from the web app.
Model deployment	USN-11	As an administrator, I can deploy the AI model in IBM Cloud.	Model's prediction should be available for users to make decision.

## CHAPTER 6

### PROJECT PLANNING & SCHEDULING

#### Sprint planning & Estimation

<b>Sprint</b>	<b>Functional Requirement (Epic)</b>	<b>User Story Number</b>	<b>User Story / Task</b>	<b>Story Points</b>
Sprint-1	Collection of Dataset	USN-1	As a user, I can collect the dataset for monitoring and analysing.	5
Sprint-1	Home page	USN-2	As a user, I want to know to about the basics of frequently occurring Disasters.	5
Sprint-1	Intro page	USN-3	As a user, I want to about the introduction of Disaster in particular areas.	5
Sprint-1	Open webcam	USN-4	As a user, I adapt with the webcam to analyse and classify the Disaster from video capturing.	5
Sprint-2	Analysis of required phenomenon	USN-5	As a user, I can regulate certain factors influencing the action and report on past event analysis.	5

Sprint-2	Algorithm selection	USN-6	As a user, I can choose the required Algorithm for specific analysis.	5
Sprint-2	Training and Testing	USN-7	As a user, I can train and test the model using the algorithm.	10
Sprint-3	Detection and analysis of data	USN-8	As a user, I can detect and visualise the data effectively.	10
Sprint-3	Model building	USN-9	As a user, I can build with the web application.	10
Sprint-4	Integrate the web app with the AI model	USN-11	As a user, I can use Flask app to use model easily through web app.	10
Sprint-4	Model deployment	USN-12	As an administrator, I can deploy the AI model in IBM Cloud.	10

### **Sprint Delivery schedule**

<b>Sprint</b>	<b>Total Story Points</b>	<b>Duration</b>	<b>Sprint Start Date</b>	<b>Story Points Completed (as on Planned End Date)</b>	<b>Sprint Release Date (Actual)</b>
Sprint-1	20	6 Days	24 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	20	19 Nov 2022

## Reports from Jira

### Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$\begin{aligned}\text{Average velocity} &= \text{Sprint duration} / \text{velocity} \\ &= 20/6 \\ &= 3\end{aligned}$$

### Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



## **CHAPTER 7**

### **CODING & SOLUTIONING**

#### **Feature 1**

The project focuses on the analysis of intensity of Disaster for giving precautionary measures for the people living in the Danger zone.

It focuses on classifying the type of Disaster which oftenly occurs in that particular zone.

#### **Feature 2**

The accuracy of the project is improved more better than the previously submitted models.

The accuracy is improved by training and testing more images in the dataset.

## CHAPTER 8

### TESTING

#### Test cases

Test Case ID	Component	Test Scenario	Expected Result	Actual Result	Status
TC_001	Home Page	Verify user is able to see the Home page	Home page should Display	Working as expected	Pass
TC_002	Home Page	Verify the UI elements in Home page	Application should show below UI elements: Home page button Intro page button Open webcam button	Working as expected	Pass
TC_003	Home Page	Verify user is able to see the cards about Disaster	Application should show the cards about Disaster.	Working as expected	Pass
TC_004	Home Page	Verify user is able to navigate to the required page	Application should navigate to the Intro page	Working as expected	Pass
TC_005	Intro Page	Verify user is able to see the Intro page	Intro page should display	Working as expected	Pass
TC_006	Intro Page	Verify the UI Elements in Intropage	Application should show below UI elements: Home page Intro page Open webcam button	Working as expected	Pass



TC_007	Intro Page	Verify the user is able to see the introduction of the Disaster	Application should show the sentences about the Disaster	Working as expected	Pass
TC_008	Intro Page	Verify user is able to navigate to the required page	Application should navigate to the Open webcam page	Working as expected	Pass
TC_009	Webcam page	Verify user is able to see the webcam page	Webcam page is displayed	Working as expected	Pass
TC_010	Webcam page	Verify the Emergency pull button is visible while the webcam is not connected	Application should show below UI elements: a. Emergency pull button	Working as expected	Pass
TC_011	Webcam page	Verify user is able to see the output window	Application should detect the type of Disaster from the real time video	Working as expected	Pass

## User Acceptance Testing

It is to briefly explain the test coverage and open issues of the natural disasters intensity analysis and classification using artificial intelligence project at the time of the release to User Acceptance Testing (UAT).

### Defect Analysis:

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	1	0	0	2	3
Duplicate	1	0	0	0	1
External	0	0	0	0	0
Fixed	1	0	0	2	3
Not Reproduce	0	0	0	0	0
Skipped	0	0	0	1	1
Won't Fix	0	0	0	0	0
Totals	3	0	0	5	8

### Test Case Analysis:

This report shows the number of test cases that have passed, failed, and untested.

Section	Test Cases	Not Tested	Fail	Pass
Home Page	4	0	0	4
Intro Page	4	0	0	4
Open Webcam	3	0	0	3

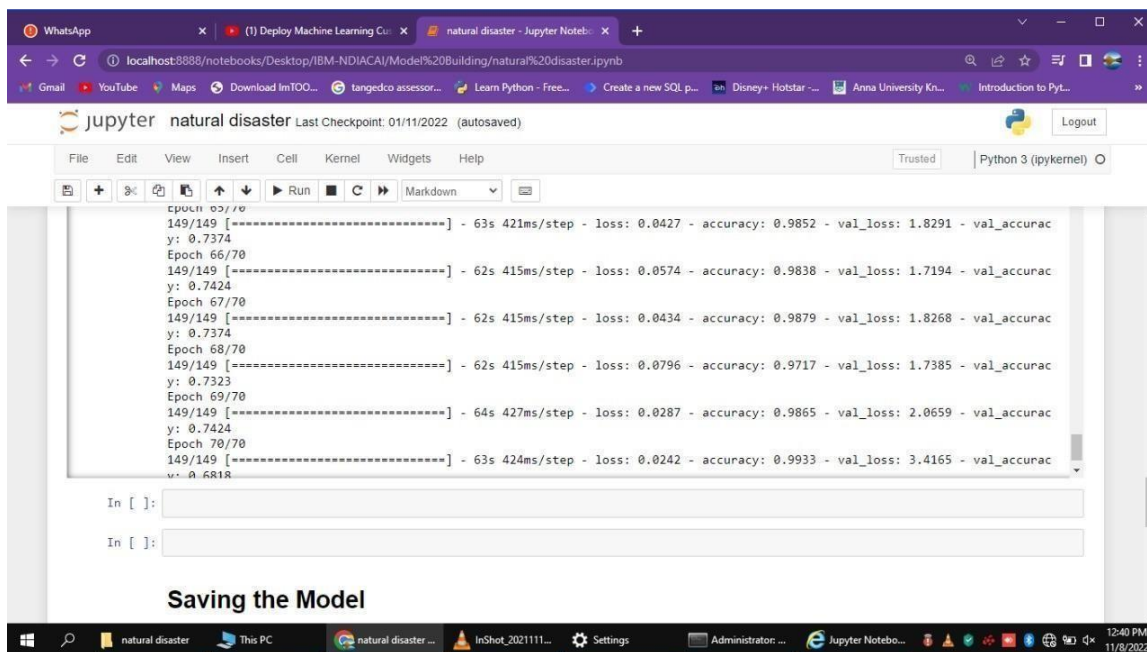
# CHAPTER 9

## RESULTS

### Performance Metrics

The nature disaster intensity analysis and classification with test data and train data has been executed successfully. The model has been trained over 1000+ images and the model have an accuracy of nearly 99% and the model has been tested with the data which is separate from the trained data and has predicted the data well.

### Output of application



The screenshot displays a Jupyter Notebook window titled 'natural disaster - Jupyter Note...'. The browser address bar shows the local path: 'localhost:8888/notebooks/Desktop/IBM-NDIACA/Model%20Building/natural%20disaster.ipynb'. The notebook interface includes a menu bar (File, Edit, View, Insert, Cell, Kernel, Widgets, Help) and a toolbar with icons for file operations, running cells, and markdown editing. The main content area shows the output of a training process, displaying metrics for epochs 66 through 70. The metrics include training time, loss, accuracy, validation loss, and validation accuracy. The final line of output shows a validation accuracy of 0.9933, indicating high performance. Below the output, there are input fields for 'In [ ]:' and a button labeled 'Saving the Model'. The Windows taskbar at the bottom shows the system clock as 12:40 PM on 11/8/2022.

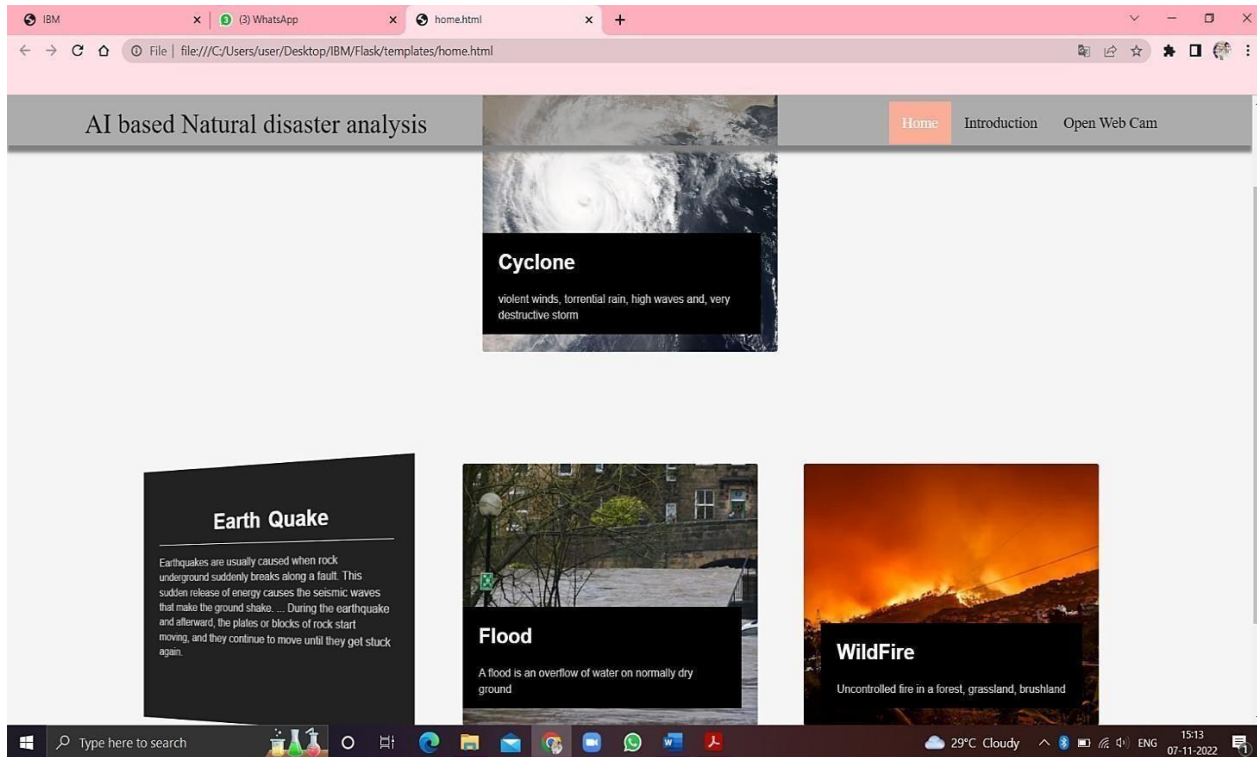
```
Epoch 66/70
149/149 [=====] - 63s 421ms/step - loss: 0.0427 - accuracy: 0.9852 - val_loss: 1.8291 - val_accuracy: 0.7374
Epoch 67/70
149/149 [=====] - 62s 415ms/step - loss: 0.0574 - accuracy: 0.9838 - val_loss: 1.7194 - val_accuracy: 0.7424
Epoch 68/70
149/149 [=====] - 62s 415ms/step - loss: 0.0434 - accuracy: 0.9879 - val_loss: 1.8268 - val_accuracy: 0.7374
Epoch 69/70
149/149 [=====] - 62s 415ms/step - loss: 0.0796 - accuracy: 0.9717 - val_loss: 1.7385 - val_accuracy: 0.7323
Epoch 70/70
149/149 [=====] - 64s 427ms/step - loss: 0.0287 - accuracy: 0.9865 - val_loss: 2.0659 - val_accuracy: 0.7424
Epoch 70/70
149/149 [=====] - 63s 424ms/step - loss: 0.0242 - accuracy: 0.9933 - val_loss: 3.4165 - val_accuracy: 0.6818
```

In [ ]:

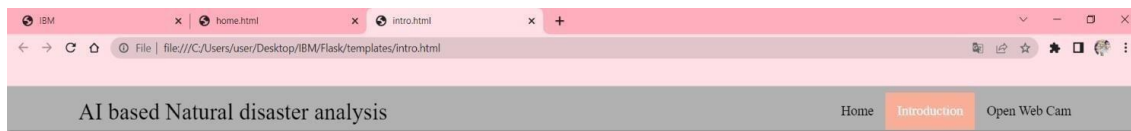
In [ ]:

**Saving the Model**

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# INTRODUCTION PAGE

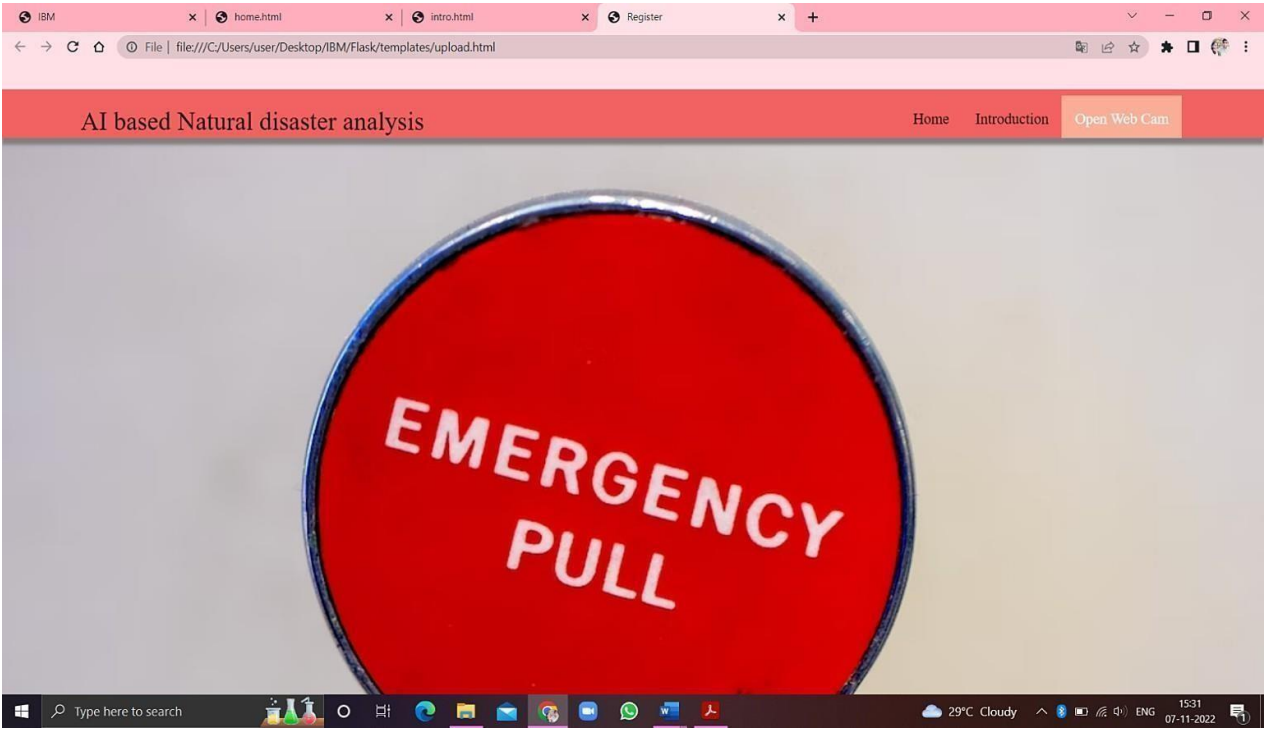


China, India and the United States are among the countries of the world most affected by natural disasters.

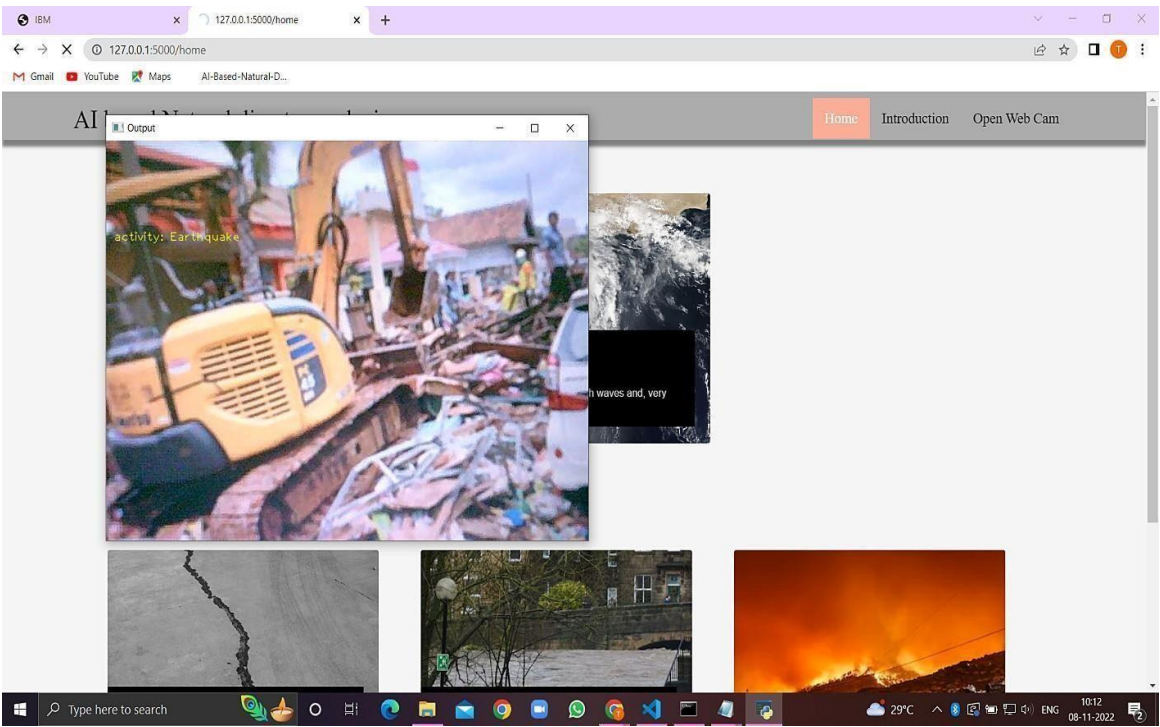
Natural disasters have the potential to wreck and even end the lives of those people, who stand in their way. However, whether or not you are likely to be affected by a natural disaster greatly depends on where in the world you live, The objective of the project is to human build a web application to detect the type of disaster . The input is taken from the in built web cam, which in turn is given to the pre trained model . The model predicts the type of disaster and displayed on UI.

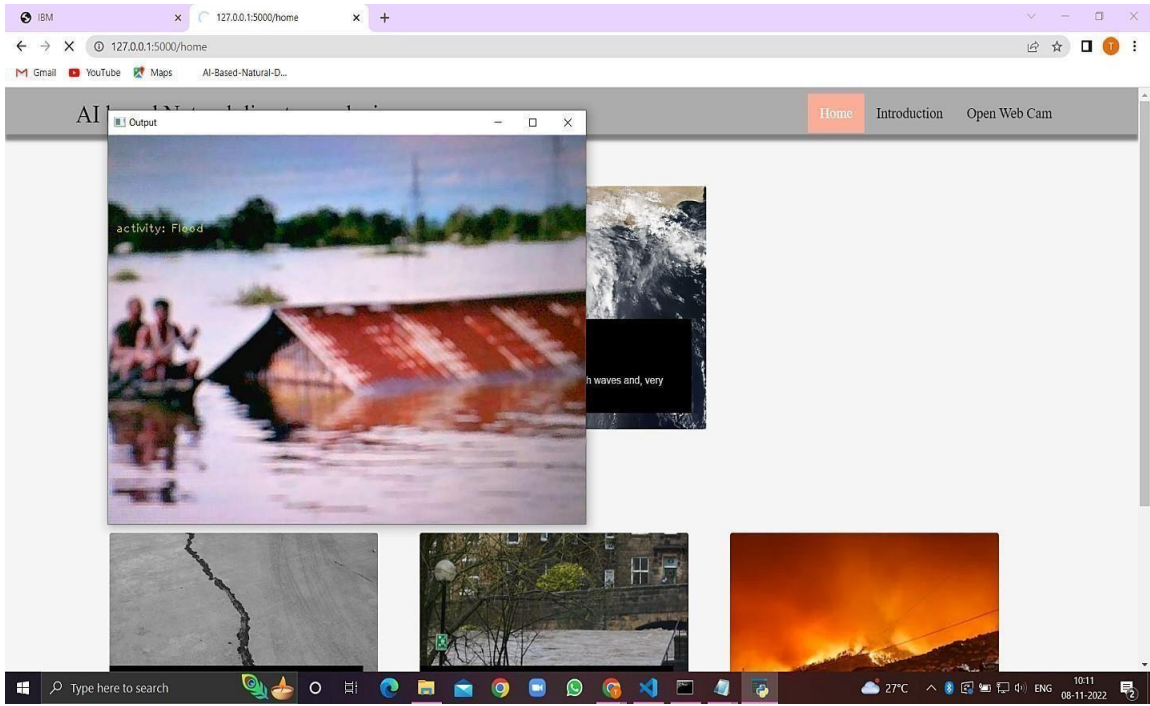


# WEB CAM



# DETECTION OF NATURE DISASTER





## **CHAPTER 10**

### **ADVANTAGES & DISADVANTAGES**

#### **ADVANTAGES**

1. The proposed model will be used as a real time natural disaster detection model and provide some upcoming predictions for future disasters.
2. The model is to detect and classify the type of disaster and The model have a high accuracy rate ( 99.33).
3. The model was used to prevent natural disasters in the future and model can be used to predict future disasters and take some action against heavy loss of human ecological systems and property.
4. The proposed system helps to reduce the impact of hazards occur during natural disaster. This provides an efficient way to warn and educate people about disaster prone areas.
5. It will help us be prepared in times of disaster

#### **DISADVANTAGES**

1. The resultant model unable to validate the model performance under uncontrolled conditions.
2. The model cannot be used for various natural disaster



## **CHAPTER 11**

### **CONCLUSION**

It focused how image from given dataset (trained dataset) in field and past data set used predict the pattern of different nature disaster using CNN model. In the system had applied different type of CNN compared the accuracy. The natural disaster in Indonesia frequently happened, due to the geographical position of the country. Thus, natural disasters mostly occurred as an impact of the natural condition. However, the weather and climate condition has also influenced and triggered the disasters.

## **CHAPTER 12**

### **FUTURE SCOPE**

In the future, the research will be continued to obtain the data from all over the country, not only west java province, and with the use of more complete analysis, so that the government or related institution could make a better anticipation work as a mitigation effort.

## CHAPTER 13

### APPENDIX

#### Inserting necessary libraries

```
import numpy as np #used for numerical analysis
```

```
import tensorflow #open source used for both ML and DL for computation
```

```
from tensorflow.keras.models import Sequential #it is a plain stack of layers
```

```
from tensorflow.keras import layers #A layer consists of a tensor-in tensor-out  
computation function
```

```
#Dense layer is the regular deeply connected neural network layer
```

```
from tensorflow.keras.layers import Dense, Flatten
```

```
#Flatten-used for flattening the input or change the dimension
```

```
from tensorflow.keras.layers import Conv2D, MaxPooling2D #Convolutional  
layer
```

```
#MaxPooling2D-for downsampling the image
```

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

```
tensorflow.__version__
```

```
tensorflow.keras.__version__
```

#### Image Data Augmentation

**#setting parameter for Image Data agumentation to the training data**

```
train_datagen =
```

```
ImageDataGenerator(rescale=1./255, shear_range=0.2, zoom_range=0.2, horizontal_  
flip=True)
```

**#Image Data agumentation to the testing data**

```
test_datagen=ImageDataGenerator(rescale=1./255)
```

**Loading our data and performing Data Augmentation**

**#performing data agumentation to train data**

```
x_train=train_datagen.flow_from_directory(r'C:\Users\vasanth\Desktop\IBM  
Project\dataset\train_set', target_size=(64, 64), batch_size=5,  
color_mode='rgb', class_mode='categorical')
```

**#performing data agumentation to test data**

```
x_test=test_datagen.flow_from_directory(r'C:\Users\vasanth\Desktop\IBM  
Project\dataset\test_set', target_size=(64, 64), batch_size=5,  
color_mode='rgb', class_mode='categorical')
```

```
print(x_train.class_indices)#checking the number of classes
```

```
print(x_test.class_indices)#checking the number of classes
```

```
from collections import Counter as c
```

```
c(x_train .labels)
```

## **Creating the Model**

### **# Initializing the CNN**

```
classifier = Sequential()
```

### **# First convolution layer and pooling**

```
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
```

```
classifier.add(MaxPooling2D(pool_size=(2, 2)))
```

```
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
```

### **# Second convolution layer and pooling**

```
classifier.add(Conv2D(32, (3, 3), activation='relu'))
```

**# input\_shape is going to be the pooled feature maps from the previous convolution layer**

```
classifier.add(MaxPooling2D(pool_size=(2, 2)))
```

```
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
```

**# Flattening the layers**

```
classifier.add(Flatten())
```

**# Adding a fully connected layer**

```
classifier.add(Dense(units=128, activation='relu'))
```

```
classifier.add(Dense(units=4, activation='softmax')) # softmax for more than 2
```

```
classifier.summary() #summary of our model
```

**# Compiling the Model**

**# Compiling the CNN**

**# categorical\_crossentropy for more than 2**

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

## **# Fitting the Model**

```
classifier.fit_generator(
```

```
    generator=x_train,steps_per_epoch = len(x_train),
```

```
    epochs=10, validation_data=x_test,validation_steps = len(x_test))# No of  
images in test set
```

## **# Saving the Model**

```
classifier.save('disaster.h5')
```

```
model_json = classifier.to_json()
```

```
with open("model-bw.json", "w") as json_file:
```

```
    json_file.write(model_json)
```

## **# Predicting Results**

```
from tensorflow.keras.models import load_model
```

```
from keras.preprocessing import image
```

```
model = load_model("disaster.h5") #loading the model for testing
```

```
img=image.load_img(r"C:\Users\vasanth\Desktop\IBMProject\dataset\test_set\Cyc  
lone\921.jpg",grayscale=False,target_size= (64,64)) #loading of the image\n
```

```
x = image.img_to_array(img)#image to array\n",
```

```
x = np.expand_dims(x,axis = 0)#changing the shape\n",
```

```
pred = model.predict_classes(x)#predicting the classes\n",
```

```
pred
```

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

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

```
result
```

**Links to find files, documents and result related to this project,**

**GitHub:** [https://github.com/ IBM-EPBL/IBM-Project-32459-](https://github.com/IBM-EPBL/IBM-Project-32459-1660210022)

[1660210022.](https://github.com/IBM-EPBL/IBM-Project-32459-1660210022)