NATURAL DISASTERS INTENSITY ANALYSIS AND CLASSIFICATION USING ARTIFICIAL INTELLIGENCE

NALAIYA THIRAN PROJECT BASED LEARNING

on

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

A PROJECT REPORT

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CHAPTER NO	TITLE	PAGE NO

CHAPTER 1

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 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.

1.2 PURPOSE

The use of artificial intelligence (AI) techniques is becoming more pervasive across a variety of industries, including consumer goods, driverless automobiles, fraud detection, and weather forecasting. The application of AI has changed a large number of these application domains.

An ongoing project aims to use AI for disaster risk analysis. This essay examines the use of AI in catastrophe risk assessments critically. Natural catastrophes not only disrupt the ecology that supports human life but they also obliterate vital facilities and properties in human society changing the ecosystem permanently. Natural occurrences like earthquakes, cyclones, floods, and wildfires can bring disaster. Several academics have used a variety of deep learning approaches to detect and categorize natural disasters to mitigate ecological damage. We suggest a multi-layered deep convolutional neural network to address this issue. The suggested model consists of two blocks: Block-I convolutional neural network (B-I CNN) for disaster detection and occurrence, and Block-II convolutional neural network (B-II CNN) for categorization of various filters and parameters for different types of natural disaster intensity. The model is put to the test on 4428 real-world photos, and its performance is calculated and expressed as the following statistical values: sensitivity (SE), specificity (SP), accuracy rate (AR), precision (PRE), and F1-score (F1). The entire model's total accuracy is 99.92%, which is competitive and correlates with cutting-edge algorithms.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

Floods are a terrible and amazing catastrophe. Floods have a serious negative influence on people's lives as well as on the economies of entire countries. It is possible to foresee floods and protect the general public from the calamity with the aid of a neural network. Convolutional neural networks and Modified Particle Swarm Optimization (MPSO) were used to create a deep learning method for anticipating flood conditions and identifying people in advance.Locating the source of a forest fire can help save lives and the economy.It is a challenging task to find victims quickly. With the aid of convolutional neural networks,assist firemen in locating casualties by spotting smoke density in photos from the unmanned aerial vehicle.Earthquakes and other calamities are more likely to happen in specific areas owing to geography. It is vital to find the victim quickly.Aerial pictures were obtained and victim location was made possible by victim detection using a convolution neural network-based architecture and a specialised ground station server.. To evaluate the framework, a simulation of actual catastrophes was created.

2.2 REFERENCE

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2.3 PROBLEM STATEMENT DEFINITION

Customer Problem Statement Template:

Create a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love. A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

Problem Statement (PS):	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 multi-layered deep convolutional neural network.
I am (CIVILIAN)	A Civilian, who is aware about natural disasters and takes the prediction methods to save nature**.**
I'm trying to	Avoid natural disasters
But	Due to natural disasters, there are droughts, economic crises, capital destruction etc.

Because	Natural disasters are increasing because of population growth, Urbanization (a lot of people in small places), alteration of the natural environment (man-made islands).
Which makes me feel	Natural disasters affect human life and destroy natural resources.

PROBLEM STATEMENT 1:

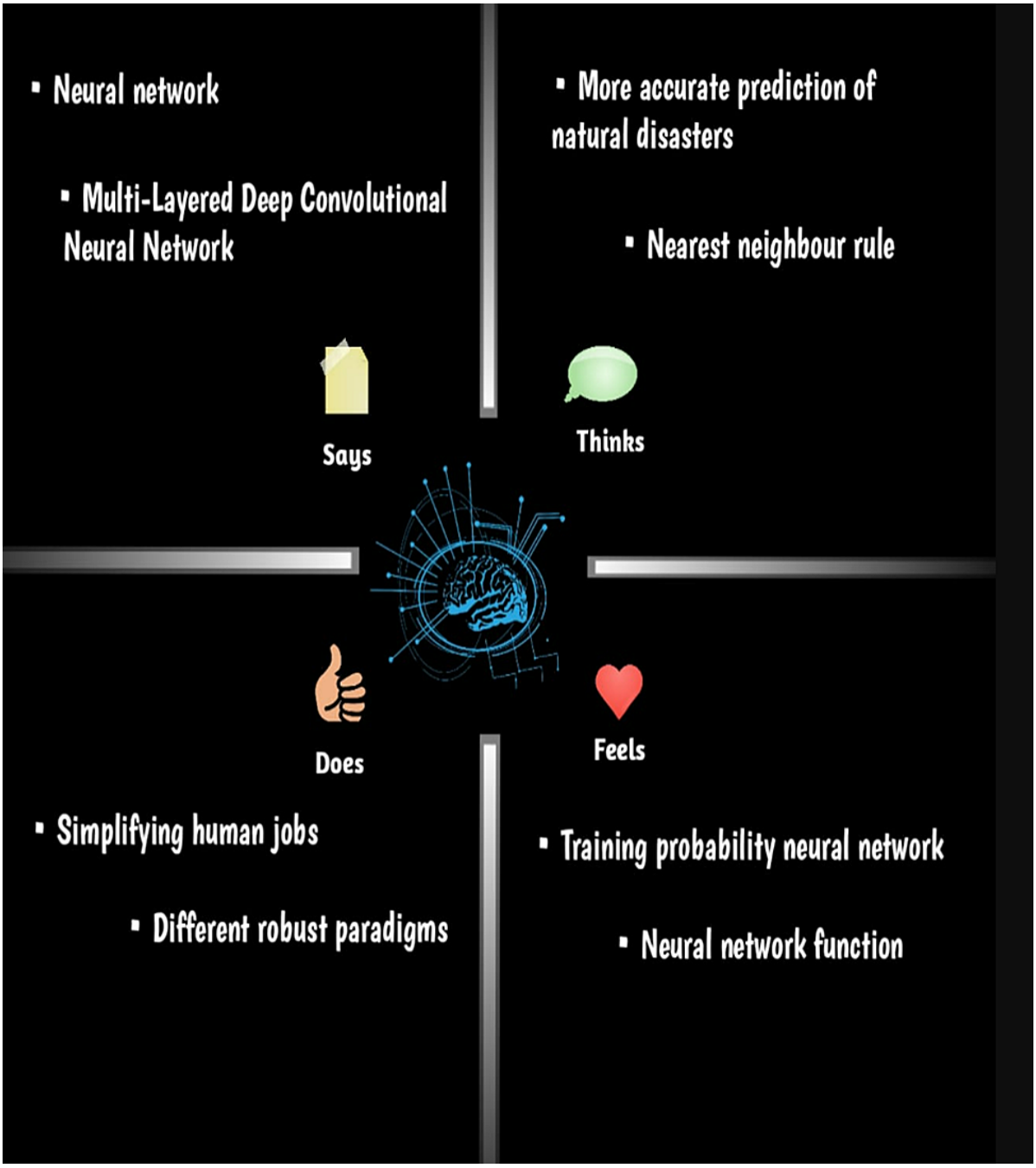
PROBLEM STATEMENT 2:

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	A civilian	Avoid natural disaster	Exists draughts, economical crisis and capital destruction, etc….	Of Urbanization and population growth	Affects millions of human lives and they an analyze the disaster priority and protect themselves from losses
PS-2	An employee from NDRF	Classify the type of natural disaster	It is difficult to identify	The data is of images and images are of various forms	Tensed and frustrated

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP

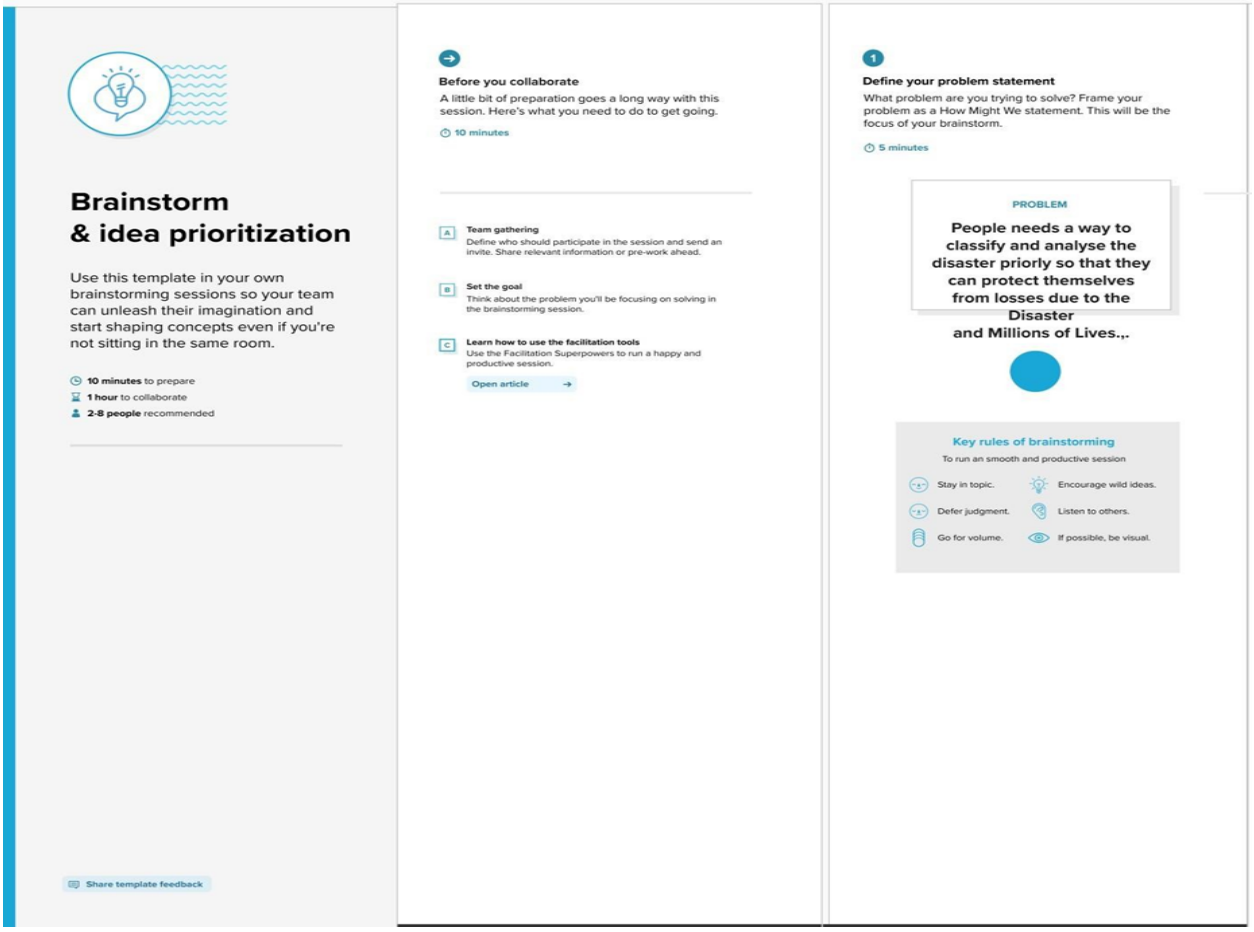


3.2 IDEATION AND BRAINSTORMING

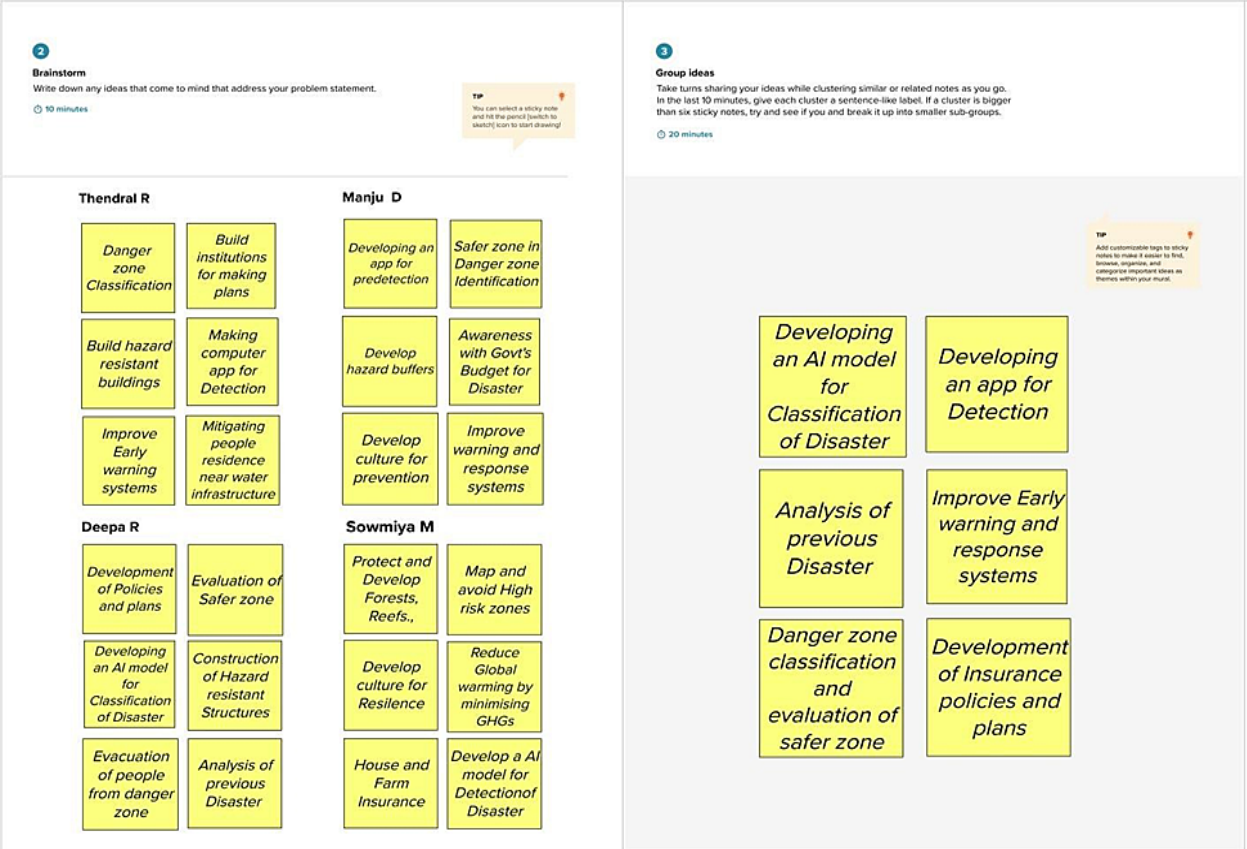
Brainstorm & Idea Prioritization Template:

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. Prioritising 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.

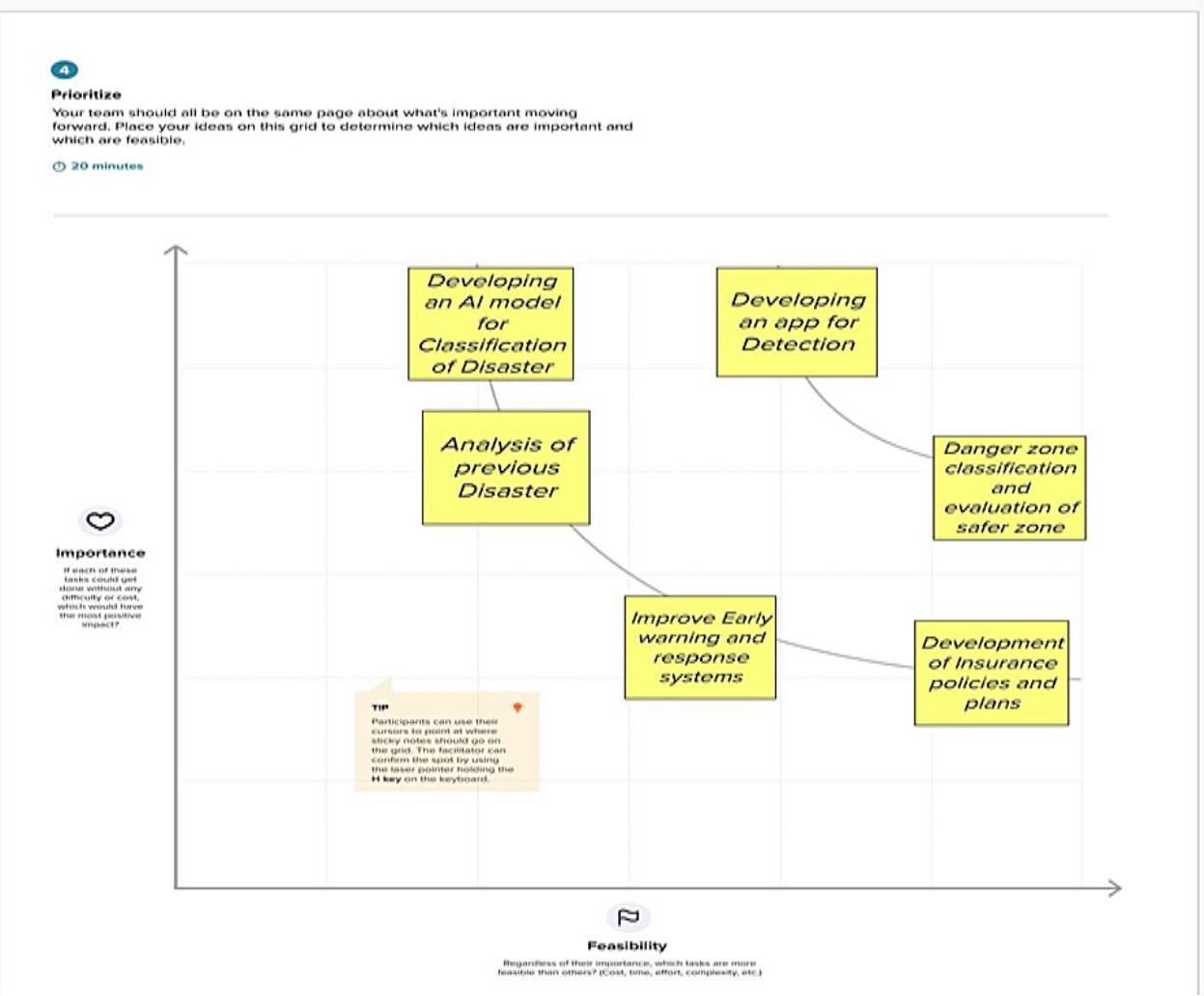
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



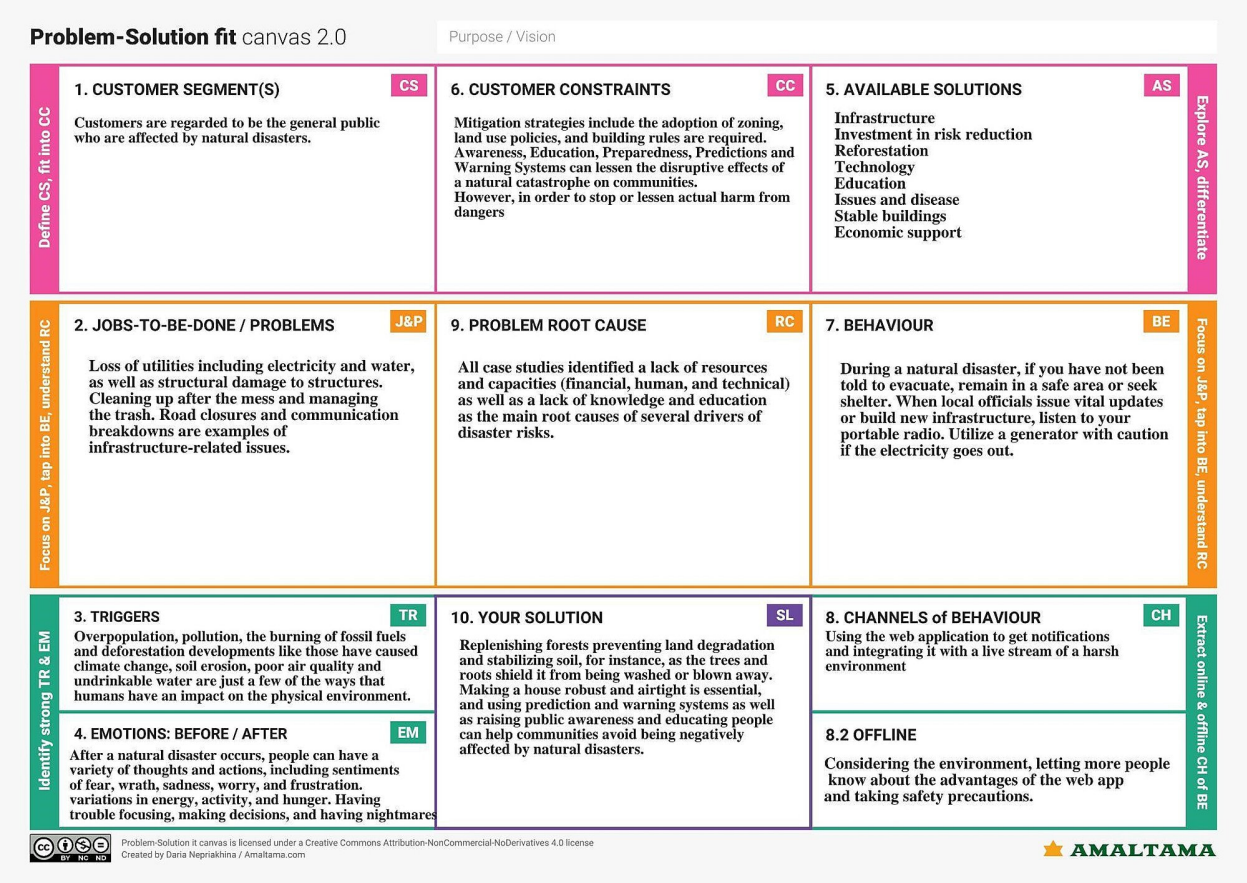
3.3 PROPOSED SOLUTION

S.NO	PARAMETER	DESCRIPTION
1.	Proposed Statement (Problem to be solved)	The main purpose of this model is to detect and classify the type of disaster with a high accuracy rate. To prevent natural disasters in the future, said model can be used to predict future disasters and take some action against heavy loss of human ecological systems and property
2.	Idea / Solution Description	We propose a multilayered deep convolutional neural network. The proposed model works in two blocks: ● Block-I convolutional neural network (B-I CNN), for detection and occurrence of disasters ● Block-II convolutional neural network (B-II CNN), for classification of natural disasters intensity types with different filters and parameters

3.	Novelty / Uniqueness	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 address these problems, we proposed multi-layered deep convolutional neural net-work 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.
4.	Social Impact / Customer Satisfaction	Buildings collapse, ailments spread and sometimes natural disasters such as tsunamis, earthquakes, and forest fires can devastate nations.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.

5.	Business Model (Revenue Model)	The proposed multilayered deep convolutional neural network was simulated on the computer system with Core i7, Central Processing Unit (CPU) 2.8 Ghz with 16 GB RAM in MATLAB 2018a and different types of results were calculated
6.	Scalability of the solution	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.

3.4 PROBLEM SOLUTION FIT



CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR - 1	**User Registration**	• Registering via Google Accounts • Registering via Product's own user management system
FR - 2	**User Authentication**	• Verification through OTP • Verification through Email Link
FR - 3	**Designation of Region**	• Ease of selection of necessary areas to be monitored • Versatile and Flexible operations on designated areas
FR - 4	**Analysis of Required Phenomenon**	• Simple and easy analysis on the specific phenomenon to be observed

FR - 5	**Accumulation of required Data**	• Fast and Efficient data gathering capabilities regarding past event analysis and future prediction
FR - 6	**Organising Unstructured data**	• Processing of raw and clustered data into clear and refined data which is useful for analysis and prediction tasks
FR - 7	**Algorithm selection**	• The freedom to choose from several classes of algorithm to be used in the process • Customization of algorithm to suit the needs of a specific purpose
FR - 8	**Prediction and analysis of data**	• Accurate results of the analysis provided by the process • Advanced visualization techniques to help visualize the processed data for effective observation
FR - 9	**Report generation**	• Restructuring of obtained results into clear and detailed report for future studies

4.2 NON FUNCTIONAL REQUIREMENTS

Following are the non-functional requirements of the proposed solution.

NFR No.	Non-Functional Requirement	Description
NFR - 1	**Usability**	• It is well suited for fields requiring diverse application of processes with efficiency, precision and ease.
NFR - 2	**Security**	• It provides a distinct and secure encryption layer to the system interface for additional security standards.
NFR - 3	**Reliability**	• The product is robust and is capable of execution of processes even in the most difficult and unpredictable environments.
NFR - 4	**Performance**	• The product boasts high precision and efficient working capacity which helps in escalating itsperformance to the highest degree.

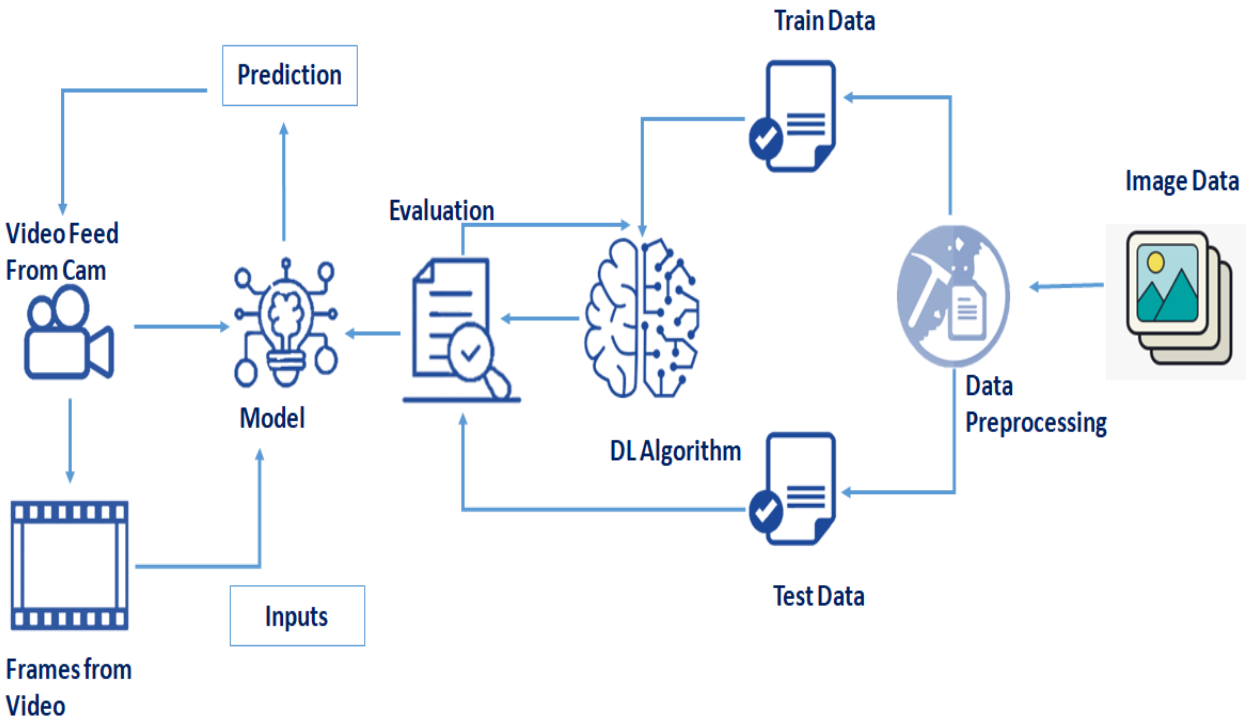
NFR - 5	**Availability**	• Despite the complexity and degree of difficulty in its operation, the product is equipped with all-round maintenance and readily available technical services which provides the necessary support any individual requires in their duties.
NFR - 6	**Scalability**	• The product 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

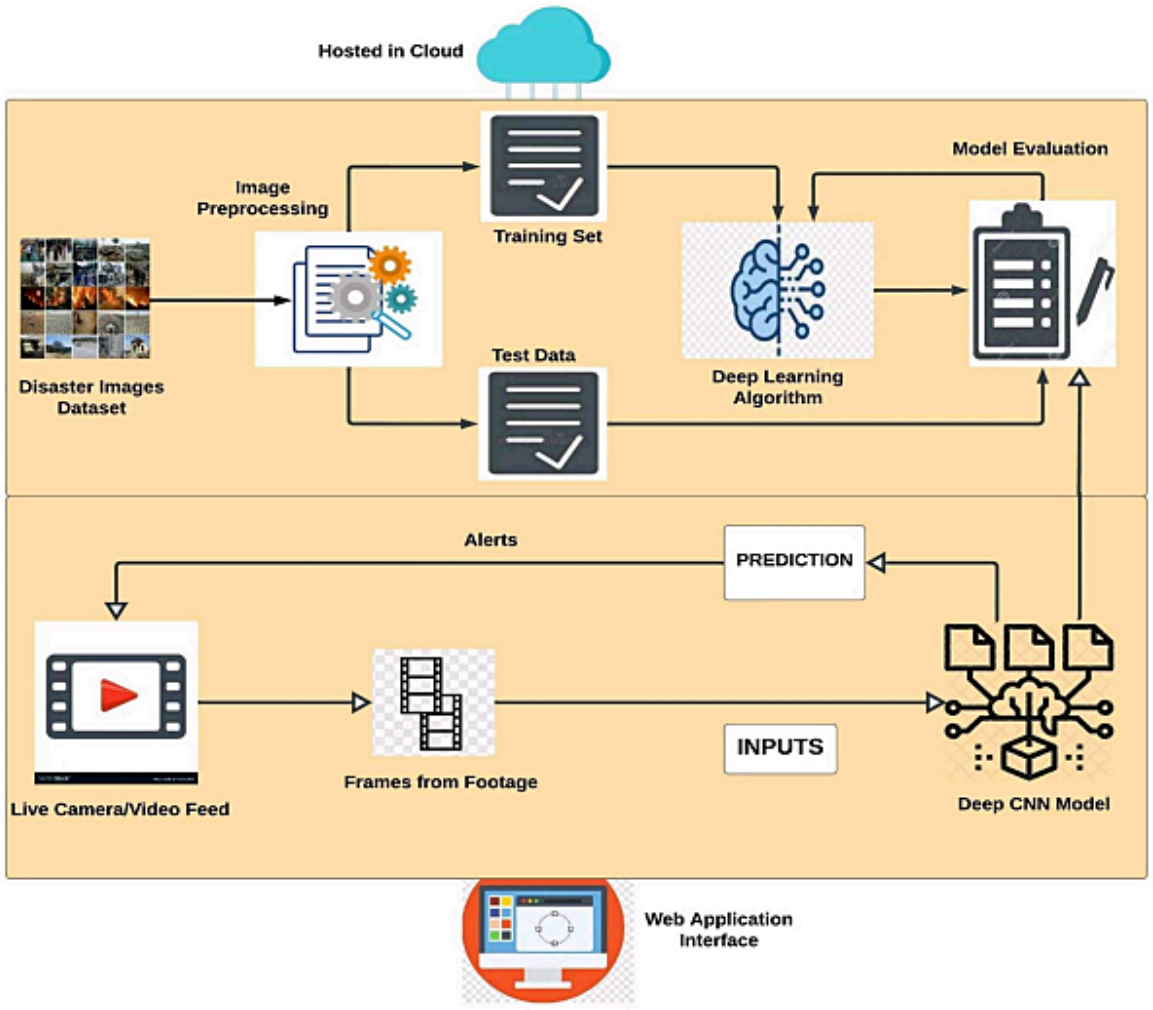
5.1 DATA FLOW DIAGRAM

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



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



TECHNICAL ARCHITECTURE

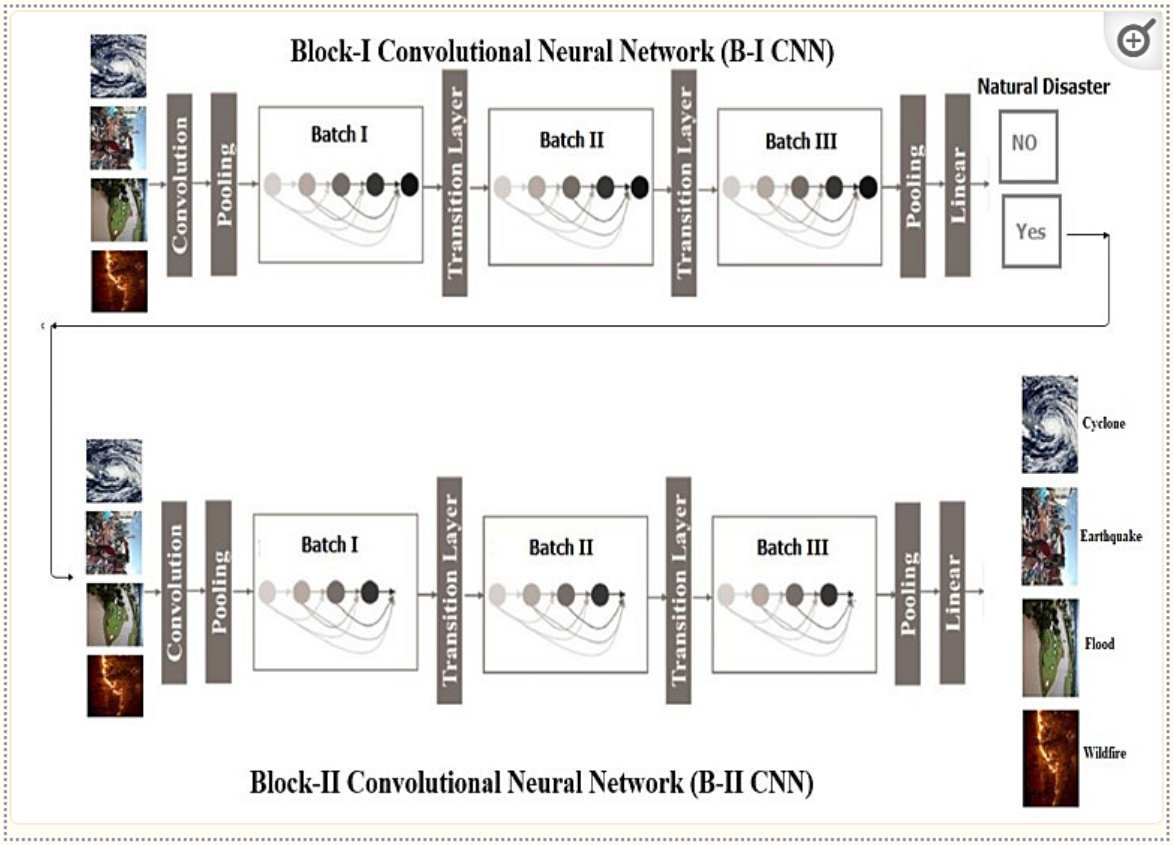


Figure 2

Table-1: Components & Technologies:

S.No	Component	Description	Technology
1	User Interface	User interacts with the application for the prediction of Any Natural disaster which will happen in future minutes.	HTML, CSS, JavaScript, Django, Python.
2	Feature Engineering Pipeline	Algorithms can't make sense of raw data. We have to select, transform, combine, and otherwise prepare our data so the algorithm can find useful patterns.	Image processing, pattern extraction, etc.
3	Model Training kit	It learns patterns from the data. Then they use these patterns to perform particular tasks.	Multiclass Classification Model, Regression Model, etc.
4	Prediction unit	This function is used to predict outcomes from the new trained data to perform new tasks and solve new problems.	Decision trees, Regression, Neural networks.
5	Evaluation system	It monitors how Algorithms perform on data as well as during training.	Chi-Square, Confusion Matrix, etc.

6	Interactive services	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 programmi ng interface, etc.
7	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.
8	Data generation system	Every machine learning application lives off data. That data has to come from somewhere. Usually, it's generated by one of your core business functions.	Synthetic data generation.
9	Database management system	An organized collection of data stored in database, so that it can be easily accessed and managed.	MySQL, DynamoDB etc.
10	IBM Cloud services	Processed data stored in cloud service which can be access by the admin anywhere over the internet.	IBM Cloud etc.

5.3 USER STORIES

User Type	Functional Requirements (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Upload Data	USN-1	As a user, I can upload either a live stream, video or photo of the disaster	I can upload the data.	High	Sprint-1
Customer (Mobile user)	Obtain Output	USN-2	As a user, I can receive the classification and the intensity of the disaster	I can receive the information about the disaster	High	Sprint-2
Customer (Web user)	Upload Data	USN-1	As a user, I can upload either a live stream, video or photo of the disaster	I can upload the data.	High	Sprint-3
Customer (Web user)	Obtain Output	USN-1	As a user, I can receive the classification and the intensity of the disaster	I can receive the information about the disaster	High	Sprint-4

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING AND SOLUTION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User input	USN-1	As a user, I can input the particular URL in the required field and waiting for validation.	2	High	Gowthamen, Geethanjaly
Sprint-1	Feature extraction	USN-1	Here system can extract feature using heuristic and visual similarity approach	1	High	Gowthamen, Archana
Sprint-1	Prediction	USN-1	Here the Model will predict the URL websites using Machine Learning algorithms	2	High	Archana, Geethanjaly

Sprint-1	Classifier	USN-1	Here it will send all the model output to classifier in order to produce final result	2	High	Archana, Anisha
Sprint-1	Announcement	USN-1	Displays whether website is a legal site or a phishing site.	1	High	Gowthamen, Anisha
Sprint-2	Bugs	USN-2	As a user, I can report bugs in the application	1	Medium	Anisha, Gowthamen
Sprint-2	Feedback	USN-3	As a user, I can send feedback about the application and opinions for improvement	1	Low	Geethanjaly, Anisha
Sprint-3	Tips	USN-4	Here cyber security tips are provided for the Customers/ Users	1	Low	Geethanjaly, Archana

6.2 SPRINT DELIVERY SCHEDULE

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

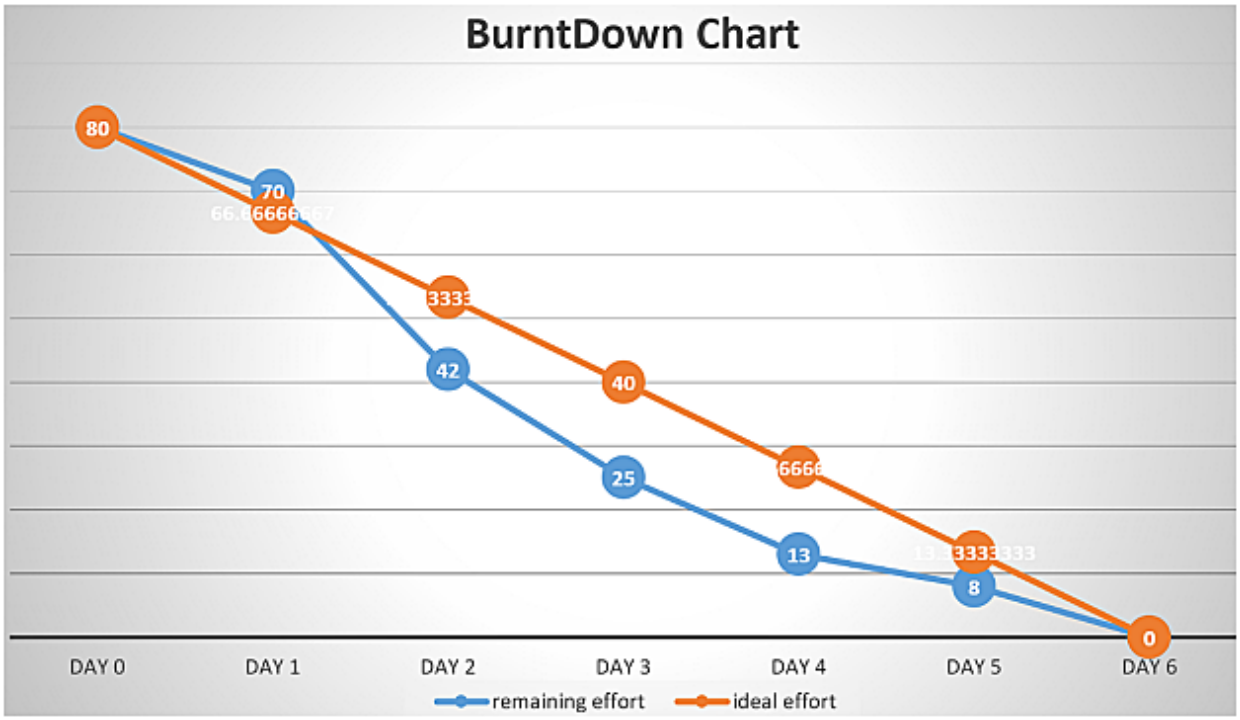
VELOCITY :

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)

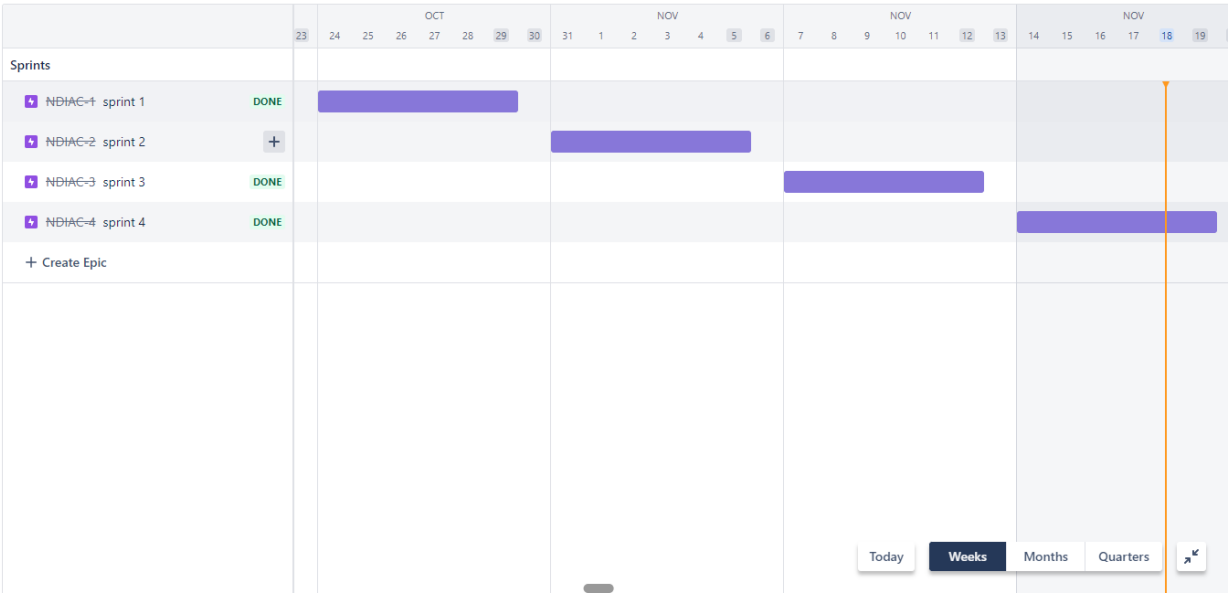
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

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.



6.3 REPORT FROM JIRA



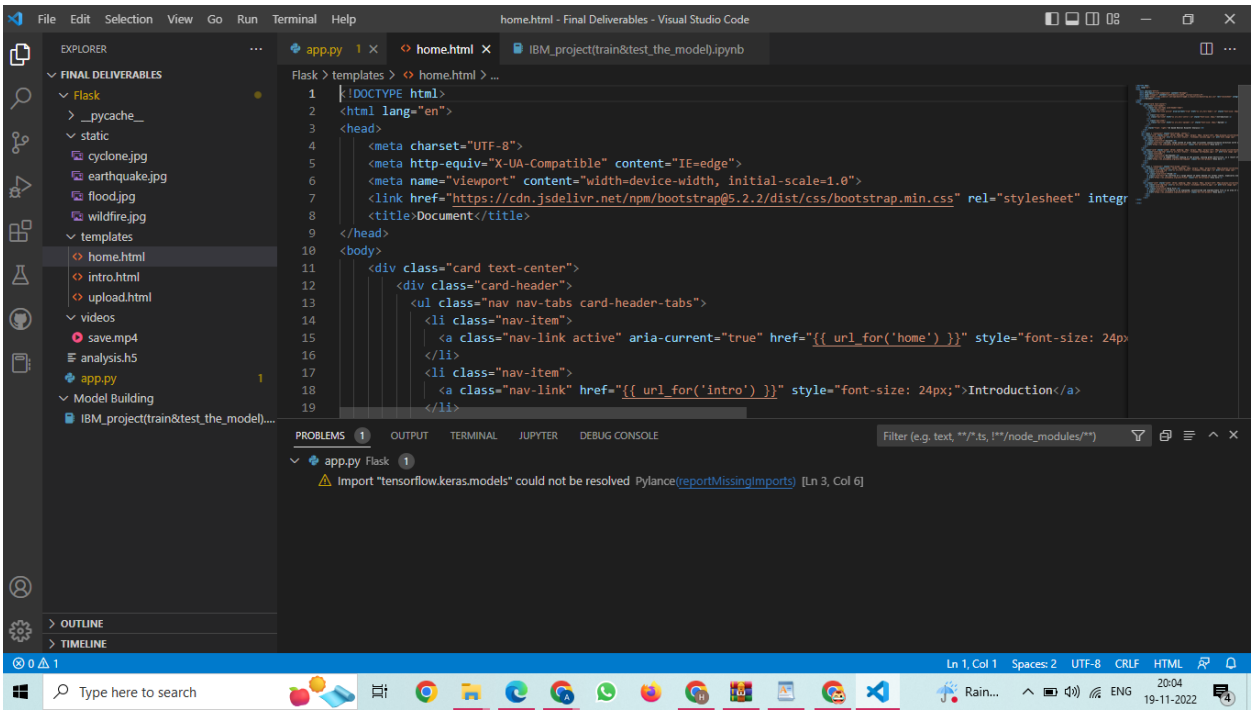
CHAPTER 7

CODING AND SOLUTION

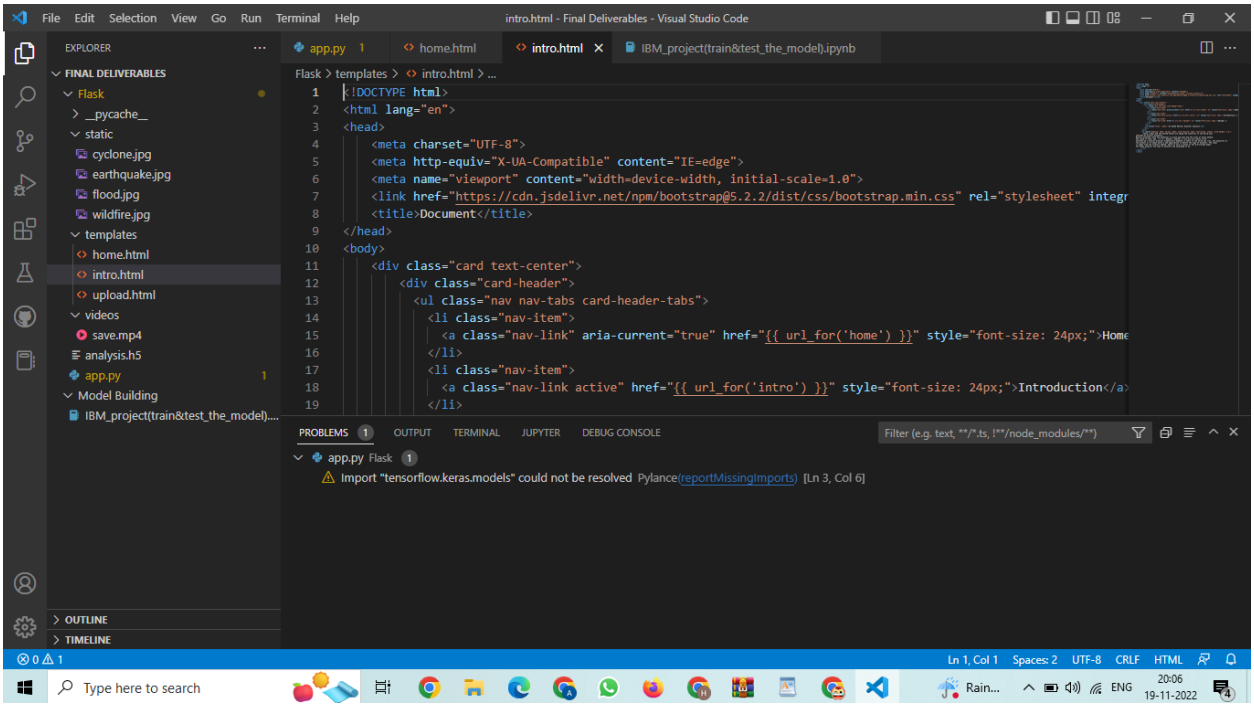
7.1 FEATURE 1

A convolutional neural network is a class of artificial neural networks. It is a Deep Learning algorithm that can take in an input image, assign importance to various objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. The advantage of CNNs is to provide an efficient dense network which performs the prediction or identification efficiently. Code is attached below.

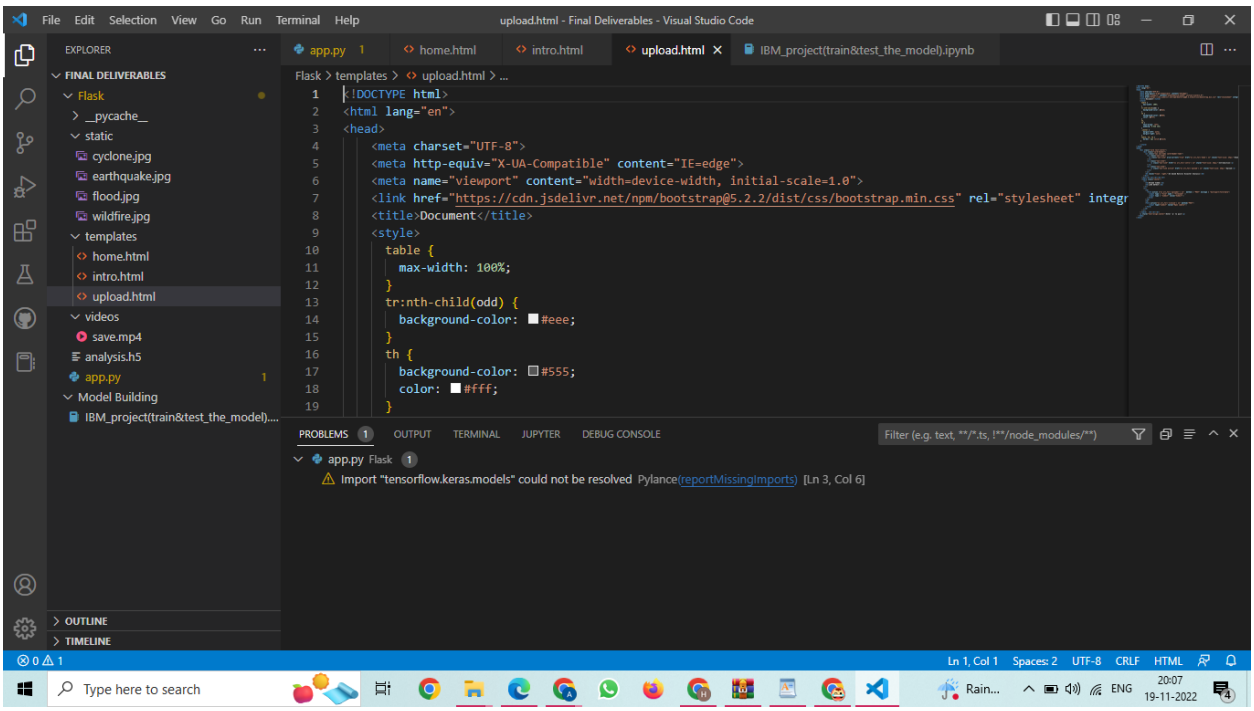
Home.html



Intro.html



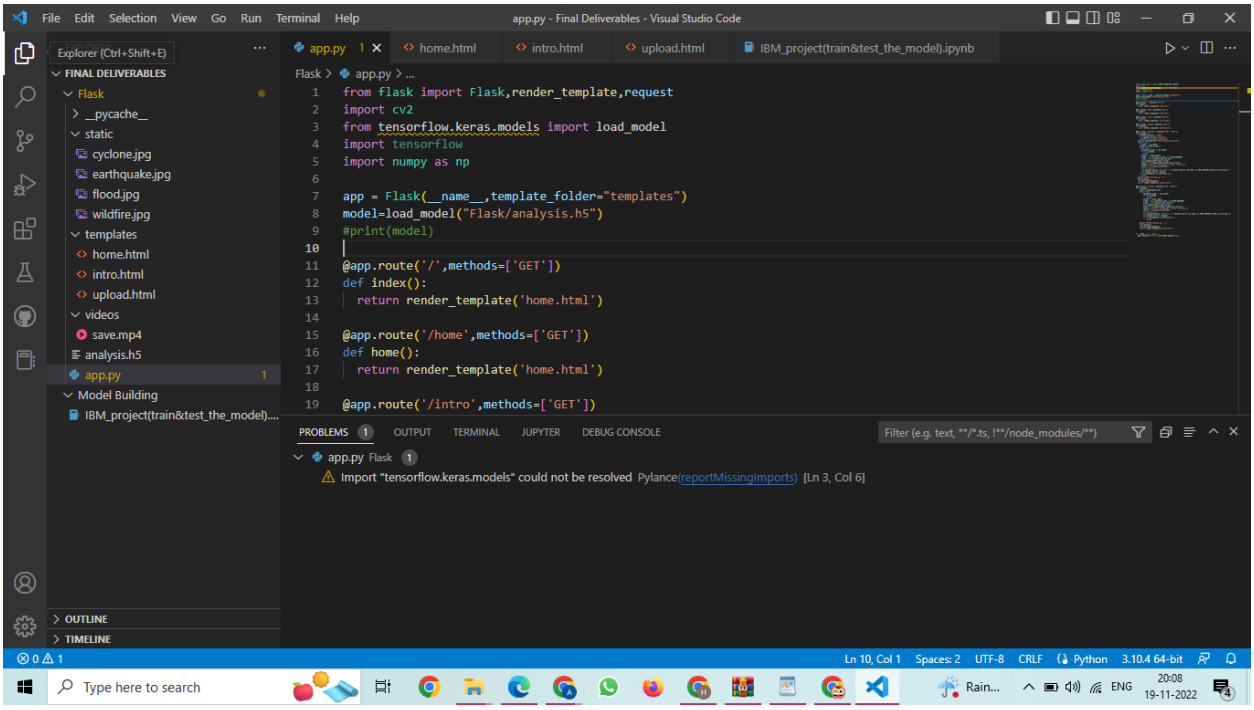
Upload.html



7.2 FEATURE 2

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. A multilayer neural network with appropriate weights has been shown to be able to approximate any input-output function making it an attractive tool for modeling and forecasting. Code is attached below.

APP.PY



CHAPTER 8

TESTING

8.1 TEST CASES

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

8.2 USER ACCEPTANCE TESTING

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

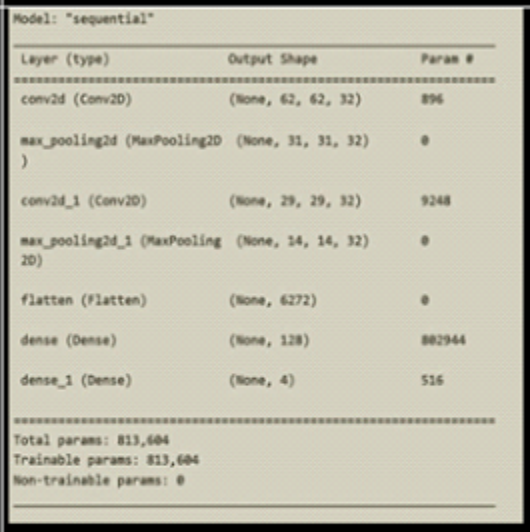
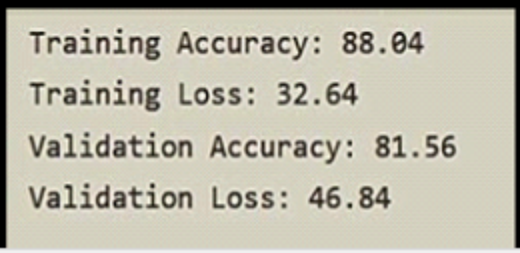
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Total
By Design	1	0	1	0	2
Duplicate	0	0	0	0	0
External	0	0	2	0	2
Fixed	4	1	0	1	6
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	1	1
Won't Fix	1	0	1	0	2
Total	6	1	4	3	14

CHAPTER 9

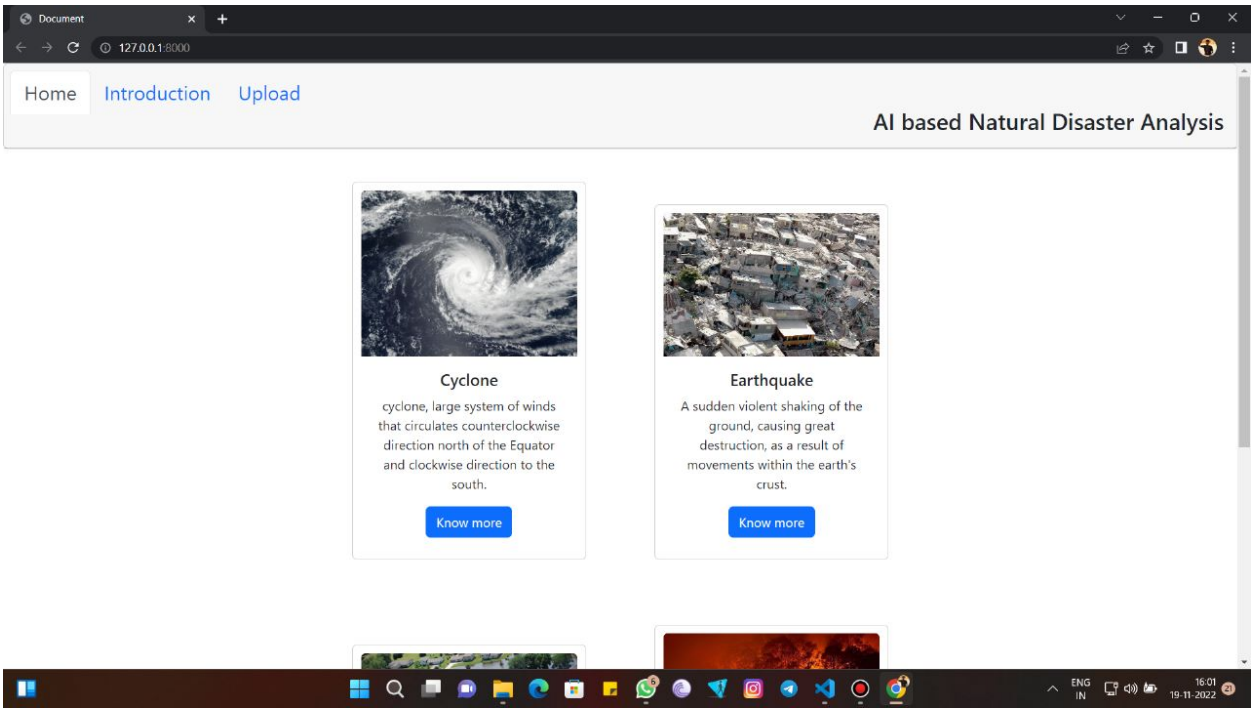
RESULTS

9.1 PERFORMANCE METRICES

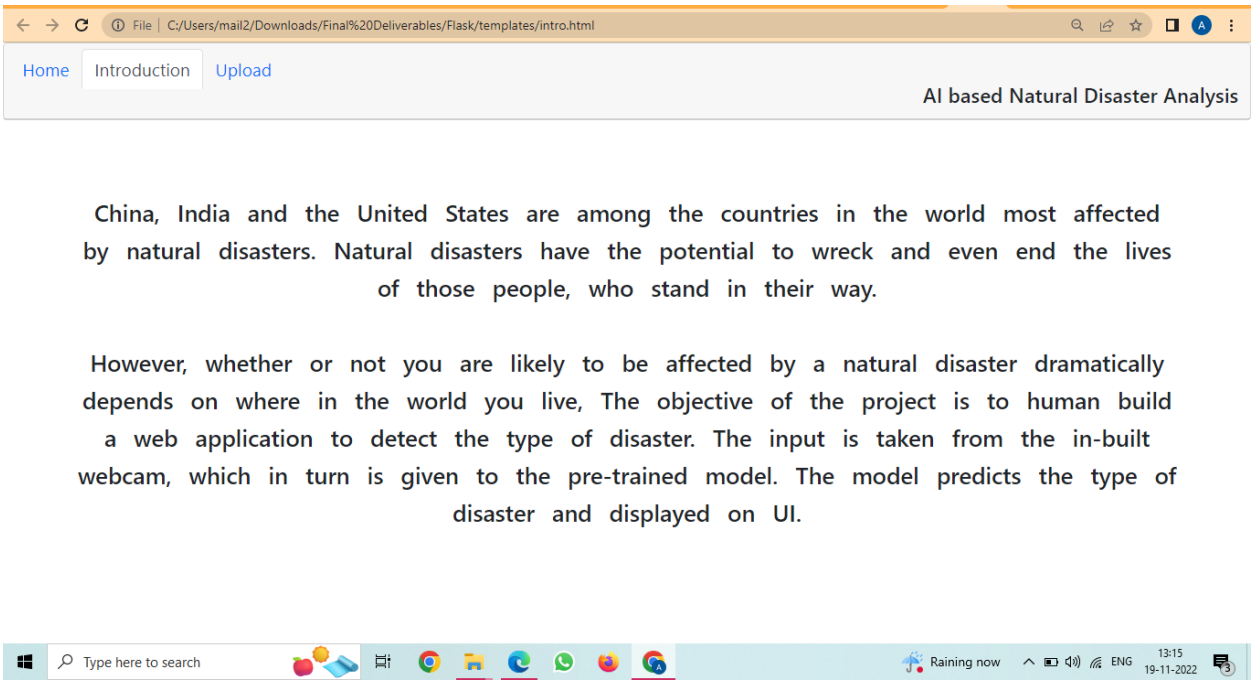
The nature disaster intensity analysis and classification with test data and train data has been executed successfully. The model has been trained over 1000+ images and the model have an accuracy of nearly 99% and the model has been tested withthe data which is separate from the trained data and has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

S.No.	Parameter	Values	Screenshot
1.	Model Summary	-	
2.	Accuracy	Training Accuracy – 88.04% Validation Accuracy -81.56%	

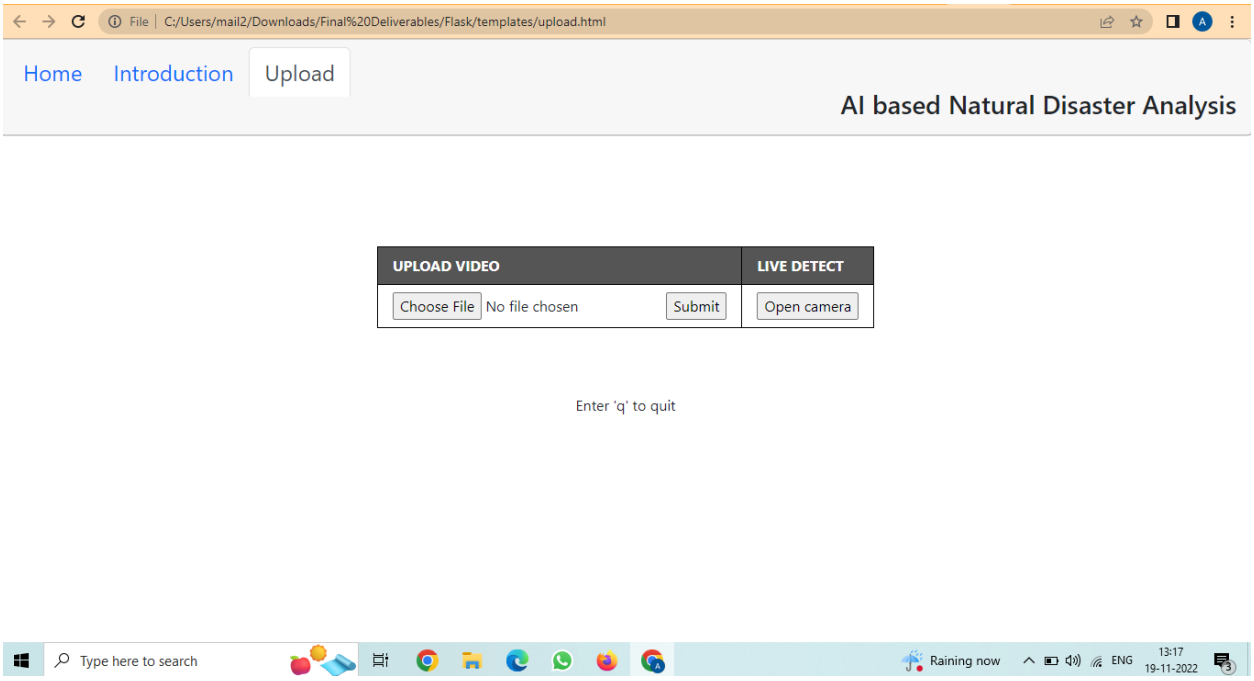
HOME PAGE



INTRO PAGE



UPLOAD PAGE



RESULT PAGE

CHAPTER 10

ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

- By predicting the occurrence of natural disasters, we can save thousands of lives and take appropriate measures to reduce property damage.
- Update current in the government organization.
- Predictions and warnings can also reduce damage and economic losses.
- AI can help detect and prepare for extreme weather and other hazards. A team at Lancaster University created a disaster mapping and damage detection system that allows rescue teams to prioritize designated areas in their relief efforts.
- Technology has enabled governments to look into measures that were not possible before. With efficient geo-location and scanning technologies, it is beneficial for the government to predict the area of impact before a disaster. Big data and other technologies also help in early information.
- So errors are reduced and the chance of reaching accuracy with a greater degree of precision is a possibility. Example: In Weather Forecasting using AI they have reduced the majority of human error.

- It improves work efficiency so reduce the duration of time to accomplish a task in comparison to humans.

10.2 DISADVANTAGES

- Getting outfitted costs a lot of money.
- Issues with basic necessities.
- Robots are one use of artificial intelligence that are replacing jobs and raising unemployment.
- Machines can only do jobs for which they are created or programmed; if they are asked to complete anything else, they frequently fail or produce useless results, which can create serious problems.

CHAPTER 11

CONCLUSION

Several researchers have tried to employ various deep learning techniques for detection. List natural catastrophes Deep learning algorithms for natural disaster detection still have a number of concerns with noise and severe class imbalances. We suggested a multilayered deep convolutional neural network for natural disaster identification and intensity classification to overcome these issues. The suggested method consists of two blocks: the first block is used to identify natural disasters, and the second block is used to address concerns with unequal class representation. Average statistical values for the outcomes were determined, and they were as follows for the proposed model: sensitivity, 97.54%; specificity, 98.22%; accuracy rate, 99.92%; precision, 97.79%; and F1-score, 97.97%. Due to its multilayered nature, the proposed model outperformed other cutting-edge techniques in terms of accuracy. So the suggested approach performs noticeably better at identifying and categorizing natural disasters, but it can be used for a variety of natural disaster detection procedures in the future.

CHAPTER 12

FUTURE SCOPE

Google's pilot effort in Patna, India, to use artificial intelligence to monitor floods, was a success last year. With an accuracy of over 90%, they were able to foresee floods and the areas that would be impacted by the natural calamity. It was made feasible by a mix of information from government organizations that supply on-the-ground data, including measurements taken with on-the-ground measuring devices and satellite photographs of flood-prone locations. To forecast the flow of water, they performed hundreds of thousands of simulations using its machine learning (ML) models. By using AI, disaster management organizations can deploy robots, sensors, and drones in the future to offer precise information on damaged structures and landscapes, impending floods, and safer rescue missions. Smart technology must be included into our neighborhood communities. The degree of the harm can be decreased with an immediate response and technological remedies. However, there are some restrictions and mistakes with AI because it is based on machine codes. However, combining human empathy with vigilance could be extremely beneficial in the realm of crisis management.

CHAPTER 13

13.1 SOURCE CODE

APP.PY :

```
from flask import Flask,render_template,request
import cv2
from tensorflow.keras.models import load_model
import tensorflow
import numpy as np
app = Flask(__name__,template_folder="templates")
model=load_model("Flask/analysis.h5")
#print(model)
@app.route('/',methods=['GET'])
def index():
  return render_template('home.html')
@app.route('/home',methods=['GET'])
def home():
  return render_template('home.html')
@app.route('/intro',methods=['GET'])
def intro():
  return render_template('intro.html')
@app.route('/upload',methods=['GET'])
def upload():
  return render_template('upload.html')
@app.route('/uploader',methods=['GET','POST'])
def uploader():
  if request.method == "POST":
    f = request.files['filename']
    f.save("Flask/videos/save.mp4")
  cap=cv2.VideoCapture("Flask/videos/save.mp4")
  while(True):
```

```
    _,frame = cap.read()
    frame=cv2.flip(frame,1)
    while(True):
      (grabbed,frame) = cap.read()
      if not grabbed:
        break
      output = frame.copy()
      frame = cv2.cvtColor(frame,cv2.COLOR_BGR2RGB)
      frame = cv2.resize(frame,(64,64))
      x=np.expand_dims(frame,axis=0)
      result = np.argmax(model.predict(x),axis=1)
      index=['Cyclone','Earthquake','Flood','Wildfire']
      result = str(index[result[0]])
      #print(result)
      cv2.putText(output,"activity:
{}".format(result),(10,120),cv2.FONT_HERSHEY_PLAIN,1,(0,25,255),1)
      cv2.imshow("Output",output)
    if cv2.waitKey(0) & 0xFF==ord('q'):
      break
  print("[INFO]cleaning up...")
  cap.release()
  cv2.destroyAllWindows()
  return render_template("upload.html")
@app.route('/livecam',methods=['GET','POST'])
def livecam():
    cap=cv2.VideoCapture(0)
    while(True):
        (grabbed,frame) = cap.read()
        if not grabbed:
            break
        output = frame.copy()
        frame = cv2.cvtColor(frame,cv2.COLOR_BGR2RGB)
        frame = cv2.resize(frame,(64,64))
        x=np.expand_dims(frame,axis=0)
        result = np.argmax(model.predict(x),axis=-1)
        index=['Cyclone','Earthquake','Flood','Wildfire']
```

```
            result = str(index[result[0]])
            #print(result)
            cv2.putText(output,"activity:
{}".format(result),(10,120),cv2.FONT_HERSHEY_PLAIN,1,(0,25,255),1)
            cv2.imshow("Output",output)
            if cv2.waitKey(0) & 0xFF==ord('q'):
                break
        print("[INFO]cleaning up...")
        cap.release()
        cv2.destroyAllWindows()
        return render_template("upload.html")
if __name__ == '__main__'
app.run(host='0.0.0.0',port=8000,debug=False
```

13.2 GITHUB AND PROJECT DEMO LINK

GITHUB LINK : Click here

DEMO LINK : Click here