

# **PROJECT REPORT**

**Team-id:PNT2022TMID00210**

## **Natural Disasters Intensity Analysis and Classification Using Artificial Intelligence.**

### **1.INTRODUCTION:**

#### **1.1 Project Overview:**

Natural disasters are inevitable, and the occurrence of disasters drastically affects the economy, ecosystem and human life. 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.

Natural disasters are the results of a hazard overwhelming highly vulnerable community, often resulting in mortality and morbidity. Over the past decade, over 300 natural disasters occur yearly around the world affecting millions and cost billions.

The disaster cycle is a framework used to base a coordinated plan to respond, recover, prevent, and prepare for a disaster. Access to clean water, proper sanitation, food/nutrition, shelter, and the threat of communicable diseases are concerns that have potential to be detrimental to the management of a natural disaster, slowing the recovery process.

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:**

Artificial intelligence (AI), in particular machine learning (ML&DL), is playing an increasingly important role in disaster risk reduction (DRR) – from the forecasting of extreme events and the development of hazard maps to the detection of events in real time, the provision of situational awareness and decision support, and beyond.

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. However, there are several objectives that are integrated with it. Those are,

1. Identifying the hazard and its cause.
2. Reducing vulnerability and potential losses of hazard.
3. Assessing, reviewing and controlling the risk.
4. Applying efficient, effective, sustainable relief (food, shelter and money), medical and other facilities in disaster affected people thus they can survive.
5. Reducing the damage, death, sufferings and destruction of any natural and human induced disaster.
6. Giving protection to victims.
7. Increasing the strength among people to survive against disasters.
8. Building up capacity in every sector like- individual, social, economic, environmental, regional, national and international.
9. Ensuring the availability of local emergency equipment and transportation.
10. Promote the culture of disaster risk prevention and mitigation at all levels.

## 2. LITERATURE SURVEY:

### 2.1 Existing problem:

Studies analyzing the intensity of natural disasters have gained significant attention in the current decade. A. Ashiquzzaman et al. [1] utilized a video source for fire detection; processing video sources is a feasible task due to convolutional neural networks (CNNs), which require high performance computational resources including graphics hardware, and thus a smart and cost-effective fire detection network is proposed based on architecture of convolutional neural networks.

In convolutional neural networks, a model to detect wildfire smoke named wildfire smoke dilated dense net was proposed by Li et al. [2], consisting of a candidate smoke region segmentation strategy using an advanced network architecture. Mangalathu et al. [4] performed an evaluation of building clusters affected by earthquakes by exploring the deep learning method, which uses long short-term memory.

Natural disasters are unpredictable events, Hartawan et al. [5] enhanced multilayer perceptron algorithm by including convolutional neural network implemented on raspberry pi to find out the victims of natural disasters using streaming cameras and to aid the evacuation team to rescue the disaster victims. Amit et al. [6] proposed applying automatic natural disaster detection to a convolutional neural network using the features of disaster from resized satellite images of landslide and flood detections. Aerial images are able to show more specific and wider surface area of the ground, which helps acquire a vast amount of information about the occurrence of disaster.

### 2.2 References:

- [1] Ashiquzzaman A., Oh S.M., Lee D., Lee J., Kim J. Springer; Berlin/Heidelberg, Germany: 2021. Context-aware deep convolutional neural network application for fire and smoke detection in virtual environment for surveillance video analysis; pp. 459–467. [[Google Scholar](#)]
- [2] Li T., Zhao E., Zhang J., Hu C. Detection of Wildfire Smoke Images Based on a Densely Dilated Convolutional Network. [[CrossRef](#)] [[Google Scholar](#)]
- [3] Mangalathu S., Burton H.V. Deep learning-based classification of earthquake-impacted buildings using textual damage descriptions. *Int. J. Disaster Risk Reduct.* 2019;**36**:101111. doi: 10.1016/j.ijdr.2019.101111. [[CrossRef](#)] [[Google Scholar](#)]
- [4] Hartawan D.R., Purboyo T.W., Setianingsih C. Disaster Victims Detection System Using Convolutional Neural Network Method; Proceedings of the 2019 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT); Bali. [[Google Scholar](#)]
- [5] Amit S.N.K.B., Aoki Y. Disaster detection from aerial imagery with convolutional neural network; Proceedings of the 2017 International Electronics Symposium on Knowledge Creation and Intelligent Computing (IES-KCIC) [[Google Scholar](#)]

## 2.3 Problem Statement Definition:

The problem statement aims at developing a multilayered deep convolutional neural network model that classifies the natural disaster and tells the intensity of natural disaster. 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.

Problem Statement is inclusive of below answers:

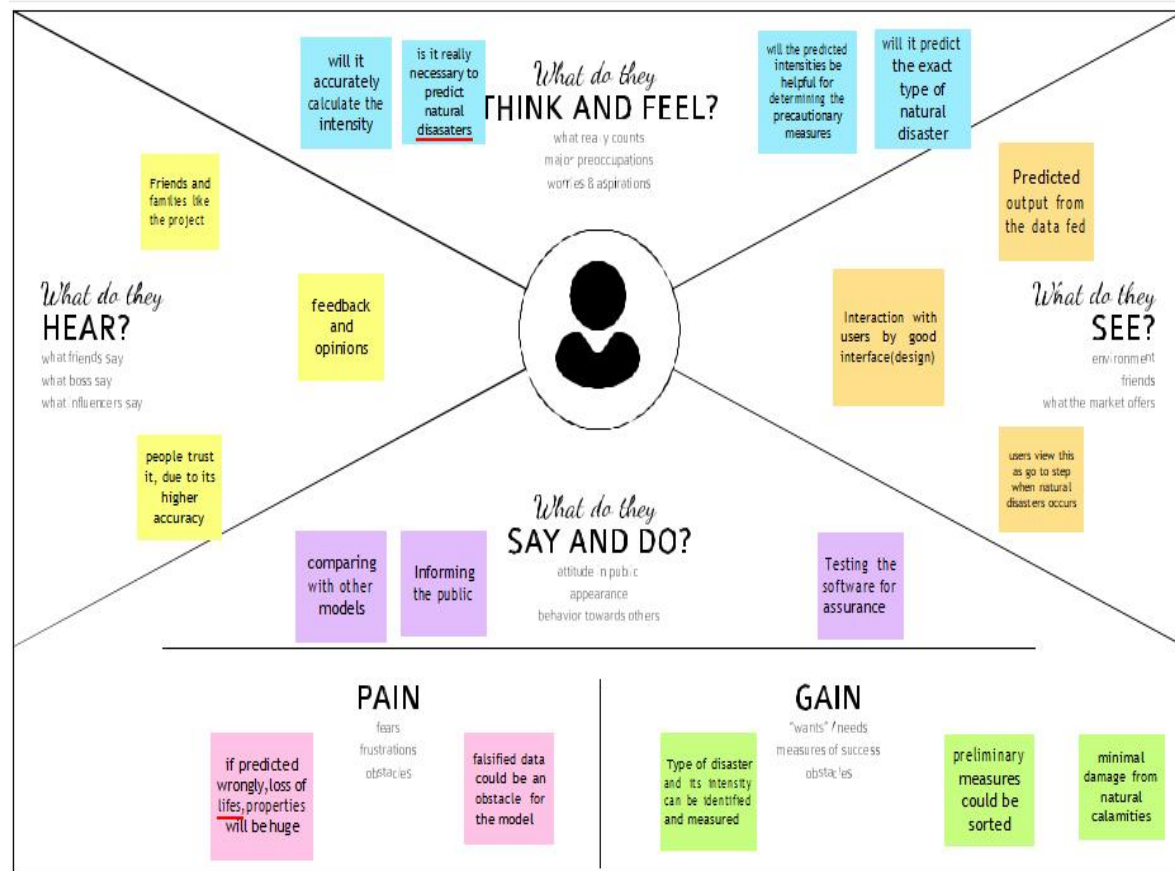
- Who does it affect/does not affect?
- What does it affect/does not affect?
- How does it affect/does not affect?
- When is it a problem/is not a problem.
- Where is it a problem/is not a problem.

Problem Statement	Description
Who does the problem affect?	The users can mostly prevent them from being a victim for natural disasters as the model predict it's intensity.
Why is it important to use?	This problem is important to use because it could help us to save our lives and properties.
What are the benefits?	Safety measures are taken with respect to the intensity outputted.
How is it better than others?	Provides results with better accuracy
When to use?	In any place, if there seen any potential threat due to the natural disaster, we could use the model


### 3. IDEATION & PROPOSED SOLUTION:

#### 3.1 Empathy Map Canvas:

Gain insights and understanding on solving customer problems.



## 3.2 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  
👤 2-8 people recommended

**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 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.
- Defer judgment.
- Go for volume.
- Encourage wild ideas.
- Listen to others.
- If possible, be visual.

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

⌚ 10 minutes

**Vignaraaj K**

- AI-based methods can be very effective if a training dataset covers very large events.
- To analyse the intent of disaster use CNN.
- To classify the disasters use ML models.
- Get insights from previous research works.

**Sivasaran C**

- The proposed model should achieve high accuracy.
- Do a literature survey.
- Use CNNs they efficiently perform feature extraction.
- Using massive volumes of high quality dataset.

**Roshan Pius**

- Information from social media can be used as data sources to carry out disaster analysis.
- prepare an outline on how to approach the problem.

**Rohith Venugopal**

- Social media is considered as a main source of big data.
- to predict future disasters.
- take some action against heavy loss of human ecological 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 10 sticky notes, try and see if you can break it up into smaller sub-groups.

⌚ 20 minutes

### Grouping bases on dataset

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

### Grouping based on literature survey

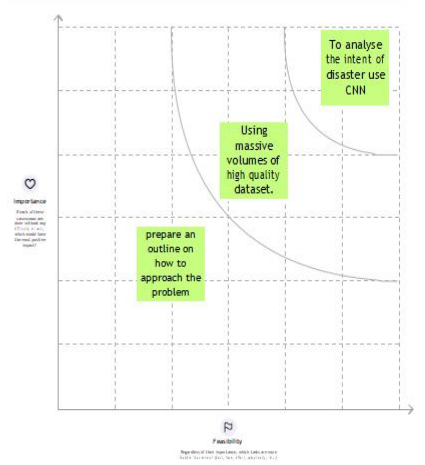
- Get insights from previous research works.
- Do a literature survey.
- prepare an outline on how to approach the problem.

### Grouping based on models

- To analyse the intent of disaster use CNN.
- find out the victims of natural disasters using screening cameras.

**Facilitate**  
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.

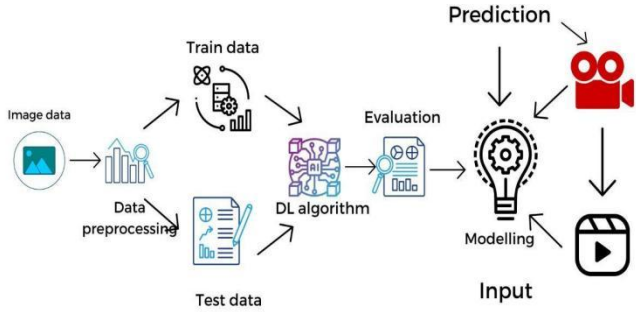
⌚ 20 minutes



**Importance**  
How important is this idea to solving the problem?  
1 = Not important at all  
2 = Somewhat important  
3 = Important

**Feasibility**  
How feasible is this idea to implement?  
1 = Not feasible at all  
2 = Somewhat feasible  
3 = Feasible

### 3.3 Proposed Solution:

S.NO.	PARAMETER	DESCRIPTION
1.	Problem statement(Problem to be solved)	To classify the natural disaster and calculate the intensity of the disaster.
2.	Idea/Solution description	To develop a multilayered deep convolutional neural network model that classifies the natural disaster and tells the intensity of disaster.
3.	Novelty/Uniqueness	We are implementing neural networks to train our model instead using machine learning algorithms which expected to provide with better accuracy.
4.	Social Impact/Customer Satisfaction	With better accuracy in predicting intensities precautions are taken respectively.
5.	Business Model(Revenue Model)	 <p>The software is cheap, and the minimum requirements are affordable.</p>
6.	Scalability of the Solution	Better accuracy in measuring the intensities of the natural disaster and in classifying it.

### 3.4 Proposed Solution fit

Problem-Solution fit canvas 2.0		Purpose / Vision	
<p><b>1. CUSTOMER SEGMENT(S)</b></p> <p>Who is your customer? i.e. working parents of 0-5 yrs kids</p> <p><b>Government Meteorological Department Victims of natural disaster</b></p>	<p><b>CS</b></p> <p><b>6. CUSTOMER CONSTRAINTS</b></p> <p>What constraints prevent your customers from taking action or limit their choices? if solutions? i.e. spending power, budget, no cash, network connection, available devices.</p> <p><b>minimum specification of GPU is required</b> <b>Access to network connection</b></p>	<p><b>CC</b></p> <p><b>5. AVAILABLE SOLUTIONS</b></p> <p>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros &amp; cons do these solutions have? i.e. pen and paper is an alternative to digital <u>notakiku</u></p> <p><b>Training the model in cloud (laas)</b> <b>Model built for classification using machine learning</b></p>	<p><b>AS</b></p> <p><b>Explore AS, differentiate</b></p>
<p><b>2. JOBS-TO-BE-DONE / PROBLEMS</b></p> <p>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one, explore different sides.</p> <p><b>Complex UI</b> <b>Inaccuracy in calculating intensities</b></p>	<p><b>J&amp;P</b></p> <p><b>9. PROBLEM ROOT CAUSE</b></p> <p>What is the real reason that this problem exists? What is the backstory behind the need to do this job? i.e. customers have to do it because of the change in regulations.</p> <p><b>Insufficient domain knowledge of customers to approach the application and insufficient data</b></p>	<p><b>RC</b></p> <p><b>7. BEHAVIOUR</b></p> <p>What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)</p> <p><b>Customers could learn how to use the application or else switch to site which has attractive UI</b></p>	<p><b>BE</b></p> <p><b>Focus on J&amp;P, tap into BE, understand</b></p>
<p><b>3. TRIGGERS</b></p> <p>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more <u>efficient</u> solution in the news.</p> <p><b>To know the necessary steps by measuring intensities</b></p>	<p><b>TR</b></p> <p><b>10. YOUR SOLUTION</b></p> <p>If you are working on an existing business, write down your current solution first fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations. saves a premium and matches customer insurance.</p> <p><b>develop a multilayered deep convolutional neural network that classifies natural disaster tells the intensity of disaster with an attractive UI</b></p>	<p><b>SL</b></p> <p><b>8. CHANNELS of BEHAVIOUR</b></p> <p>8.1 ONLINE What kind of actions do customers take online? Extract online channels from #7</p> <p><b>comments good and rates the model built high</b></p>	<p><b>CH</b></p> <p><b>Extract online &amp;</b></p>
<p><b>4. EMOTIONS: BEFORE / AFTER</b></p> <p>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure &gt; confident, in control - use it in your communication strategy &amp; offering</p> <p><b>before-&gt;Stressed</b> <b>after - Confident</b></p>	<p><b>EM</b></p> <p><b>11. OFFLINE</b></p> <p>What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</p> <p><b>encourage others to use the application</b></p>	<p><b>12. OFFLINE</b></p>	<p><b>Extract offline &amp;</b></p>



## 4. REQUIREMENT ANALYSIS

### 4.1 Functional requirement:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	<b>Designation of Region</b>	<ul style="list-style-type: none"><li>• Ease of selection of necessary areas to be monitored</li><li>• Versatile and Flexible operations an designated areas</li></ul>
FR-2	<b>Analysis of Required Phenomenon</b>	<ul style="list-style-type: none"><li>• Simple and easy analysis on the specific phenomenon to be observed</li></ul>
FR-3	<b>Accumulation of required Data</b>	<ul style="list-style-type: none"><li>• Fast and Efficient data gathering capabilities regarding past event analysis and future prediction</li></ul>
FR-4	<b>Organizing Unstructured data</b>	<ul style="list-style-type: none"><li>• Processing of raw and clustered data into clear and refined data which is useful for analysis and prediction tasks</li></ul>
FR-5	<b>Algorithm selection</b>	<ul style="list-style-type: none"><li>• The freedom to choose from several classes of algorithm to be used in the process</li><li>• Customization of algorithm to suit the needs of a specific purpose.</li></ul>
FR-6	<b>Prediction and analysis of data the process</b>	<ul style="list-style-type: none"><li>• Advanced visualization techniques to help visualize the processed data for effective</li></ul>
FR-7	<b>Report generation</b>	<ul style="list-style-type: none"><li>• Restructuring of obtained results into clear and detailed report for future studies.</li></ul>

## 4.2 Non-functional Requirements:

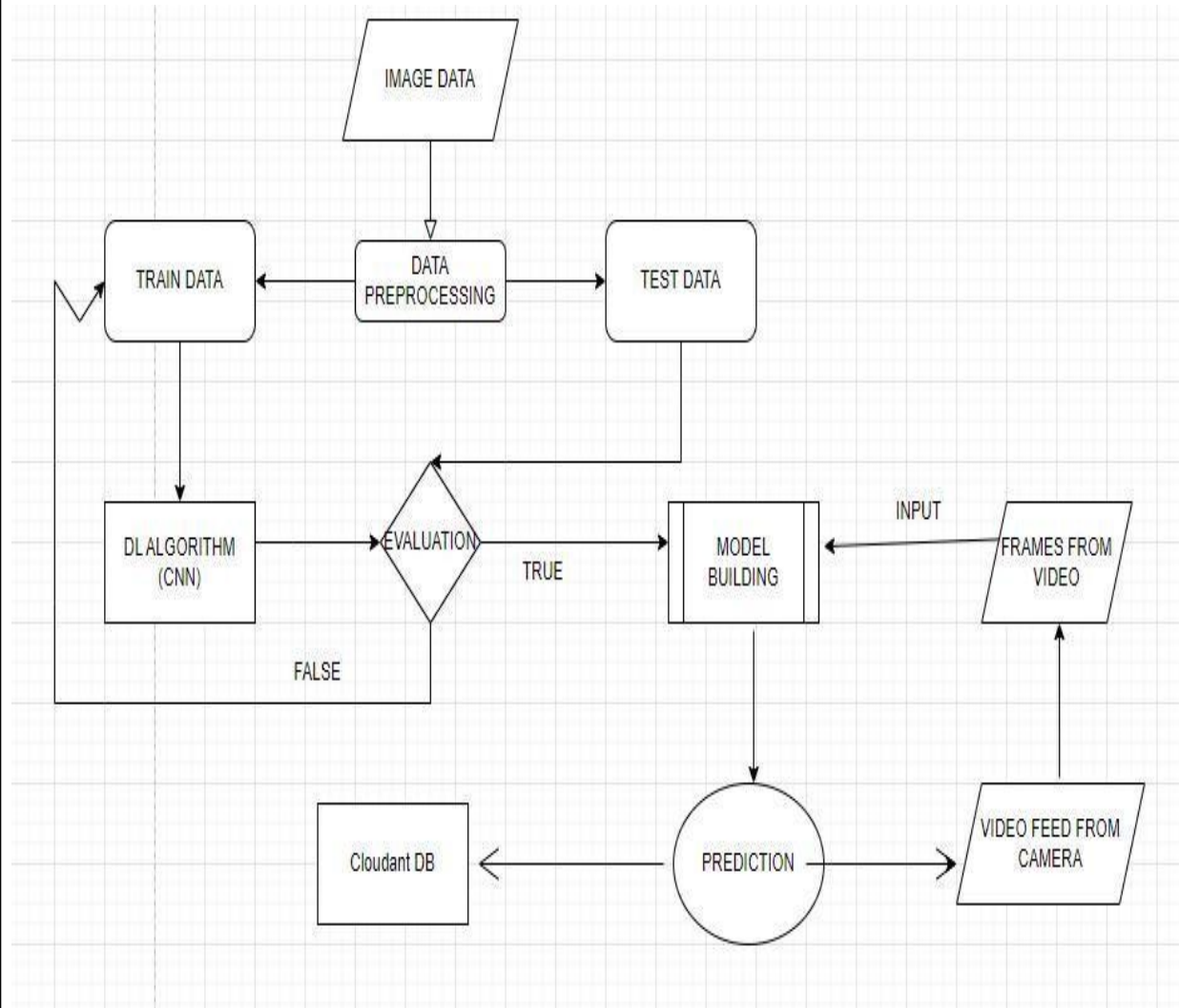
Following are the non-functional requirements of the proposed solution.

NFR No	Non-Functional Requirement	Description
NRF - 1	<b>Usability</b>	The system must be efficient and easy for the user to carry out tasks.
NRF - 2	<b>Security</b>	User details must be secured.
NRF - 3	<b>Reliability</b>	The product is robust and is capable of execution of processes even in the most difficult and unpredictable environments.
NRF - 4	<b>Performance</b>	The system should be able to handle many users without performance deterioration.
NRF - 5	<b>Availability</b>	The system should be accessible to a user at a given point in time
NRF -6	<b>Scalability</b>	The website pages should load fast with the total number of simultaneous users.

## 5. PROJECT DESIGN:

### 5.1 Data Flow Diagrams:

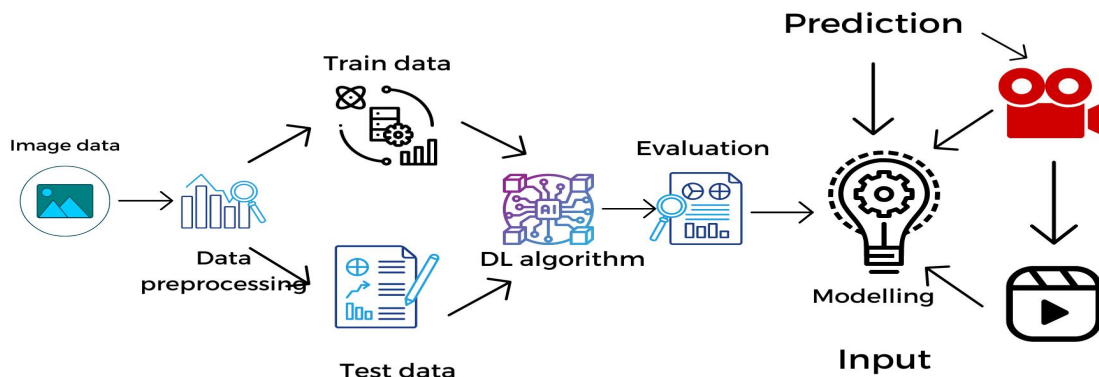
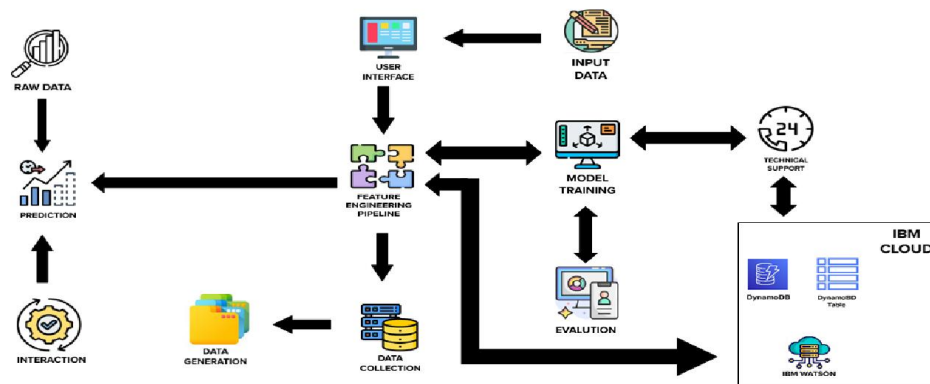
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



## 5.2 Solution & Technical 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.



## **Components & Technologies:**

### **1. User Interface**

#### **Description**

User interacts with the application for the prediction of Any Natural disaster which will happen in future minutes.

#### **Technology**

HTML, CSS, Flask, Python.

### **2. Feature Engineering Pipeline**

#### **Description**

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.

#### **Technology**

Image processing, pattern extraction, etc.

### **3. Model Training kit**

#### **Description**

It learns patterns from the data. Then they use these patterns to perform particular tasks

#### **Technology**

deep learning multilayer convolutional neural network(CNN).

### **4. Prediction unit**

#### **Description**

This function is used to predict outcomes from the new trained data to perform new tasks and solve new problems.

#### **Technology**

Neural networks.

### **5. Evaluation system**

#### **Description**

It monitors that how Algorithm performs on data as well as during training

#### **Technology**

Chi-Square, Confusion Matrix, etc.

## **6. Interactive services**

### **Description**

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

### **Technology**

Application programming interface, etc.

## **7. Data collection unit**

### **Description**

Data is only useful if it's accessible, so it needs to be stored ideally in a consistent structure and conveniently in one place.

### **Technology**

IBM Cloud, SQL Server.

## **8. Data generation system**

### **Description**

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

### **Technology**

Synthetic data generation.

## **9. IBM Cloud services**

### **Description**

Processed data stored in cloud service which can be access by the admin anywhere over the internet.

### **Technology**

IBM Cloud etc.

## **Application Characteristics:**

### **1. Open-Source Frameworks**

#### **Description**

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.

#### **Technology**

Keras, tensor flow.

### **2. Application interface**

#### **Description**

User uses mobile application and web application to interact with model

#### **Technology**

Android and Web Development (PhoneGap, ReactNative, and NativeScript).

### **3. Availability (both live camera update and upload video)**

#### **Description**

It includes both the above mentioned work. A good internet connection is needed for online work to explore the software perfectly. Offline work includes the saved data to explore for later time.

#### **Technology**

Caching, backend server.

### **4. Regular Updates**

#### **Description**

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.

#### **Technology**

- Waterfall Approach
- Incremental Approach
- Spiral Approach

### 5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	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	Dashboard	USN-2	As a user, I can access the services and information provided in the dashboard	I can create interactive interfaces using html,css	Medium	Sprint-2
Functional Requirement (Epic)	Obtain Output	USN-3	As a user, I can receive the classification and the intensity of the disaster	I can receive the information about the disaster	High	Sprint-3
Customer care	Help Desk	USN-4	As a user, I can get the guidance from the customer care	I can get help from the customer care for carrying out my tasks	Low	Sprint-4



## 6.PROJECT PLANNING & SCHEDULING:

### 6.1 Sprint Planning and Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Landing page	USN-1	As an admin, I can upload the saved video to the application	2	High	Vignaraaj, Sivasaran
Sprint-1		USN-2	As an admin, I will access the live camera and feed the input to the application	1	High	Roshan, Rohith
Sprint-2		USN-3	As an admin, I can develop code to predict output from live camera	2	Low	Sivasaran, Rohith
Sprint-2		USN-4	As an admin, I can develop code to predict output from uploaded video	2	Medium	Roshan, Vignaraaj
Sprint-1		USN-5	As a user, I can access the information about the natural disasters	1	High	Vignaraaj, Rohith
Sprint-1	Dashboard	USN-6	As a user, I can access the services and information provided in the dashboard	2	High	Sivasaran, Vignaraaj
Sprint-1		USN-7	As an admin, I can create the interactive interfaces	2	High	Vignaraaj, Sivasaran
Sprint-4	Helpdesk	USN-8	As a user, I can get the guidance from the customer care	1	High	Sivasaran, Roshan, Rohith
Sprint-3	Management	USN-9	As an administrator, I can collect new datasets and keep the model trained	2	High	Vignaraaj
Sprint-3		USN-10	As an administrator, I can update other	2	Medium	Sivasaran, Roshan

			features of the application			
Sprint-3		USN-11	As an administrator, I can maintain the information about the user	2	medium	Rohith, Sivasaran
Sprint-4		USN-12	As an administrator, I can maintain third-party services	1	Low	Roshan

## 6.2 Sprint Delivery Schedule:

Sprint	Total Story Point	Duration	Start Date	End Date (Planned)	Story Points Completed	Sprint Release Date
Sprint-1	8	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	4	6 Days	31 Oct 2022	05 Nov 2022	4	05 Nov 2022
Sprint-3	6	6 Days	07 Nov 2022	12 Nov 2022	6	12 Nov 2022
Sprint-4	2	6 Days	14 Nov 2022	19 Nov 2022	2	19 Nov 2022

## 7.CODING & SOLUTIONING:

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 CNN is to provide an efficient dense network which performs the prediction or identification efficiently.

### Feature 1:

One of the features enabled in this application is uploading the data e.g(video,image), and saving the data for further prediction. The predicted output is displayed in the screen.

**Code is attached below:**

```
@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")
```

## Feature 2:

Another feature enabled in this application is accessing the live camera using Open CV framework and processing the live video frame by frame for further prediction. The predicted output is displayed in the screen.

**Code is attached below.**

```
@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]])
        cv2.putText(output,"activity:
        {}".format(result),(10,120),cv2.FONT_HERSHEY_PLAIN,1,(0,255,255),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")
```

## 8. TESTING:

### 8.1 Test Cases

Test ID	Test Description	Test Input	Expected Result	Actual Result	Status
ID-01	Load the trained Model into the application	Analysis.h5	Prompts to next line	Prompts to the next line	Pass
ID-02	Upload the video as a customer	Disaster.mp4	File uploaded and ready for prediction	File uploaded and sent for prediction	Pass
ID-03	Open integrated camera to capture live video	Cv2.Videocapture(0)	Opens integrated live camera and records	Opens camera and split the recording frame by frame	pass
ID-04	Train and test the model	Dataset.csv	Dataset trains with a good accuracy	Provides Trained Model With high accuracy	Pass

## 8.2 User Acceptance Testing

The purpose of this document is to briefly explain the test coverage and open issues of the Natural disaster intensity analysis and classification using artificial intelligence project at the time of the release to User Acceptance Testing (UAT).

### Defect Analysis:

This shows how many bugs were fixed or closed at each severity level and how they were fixed.

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	3	2	4	14
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	10	2	4	14	30
Not Reproduced	0	0	1	0	1
Skipped	5	1	1	0	7
Won't Fix	0	5	2	1	8
Totals	23	14	13	20	70

### Test-Case Analysis:

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

Section	Total Cases	Not Tested	Failed	Pass
Print Engine	7	0	0	7
Client Application	30	0	0	24
Security	0	0	0	0
Out-source Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

## 9.RESULTS

### 9.1 Performance Metrics:

S.No.	Parameter	Values
1.	Model Summary	CNN- {optimizer:Adam,loss:categorical_ crossentropy,metrics:accuracy}
2.	Accuracy	Training Accuracy - 91.51% Validation Accuracy -73.74%

Our Project marks the successive performance by implementing in order to be cost effective and more reliable to use and to predict the future from the natural disaster that we are ahead of. The successive way includes the objectives, activities and the approaches for the project. It mainly includes the trained dataset which gives an excessive measure of success which helps to overcome the future from this natural disaster.

## 10.ADVANTAGES AND DISADVANTAGES

### ADVANTAGES:

- The use of AI to forecast natural disasters would save millions of lives. Furthermore, the information evaluated by AI-powered systems can aid in understanding the scale and patterns of natural catastrophes such as floods, earthquakes, and tsunamis, which would aid in improved infrastructure development in disaster-prone areas.

### DISADVANTAGES:

- Sometimes the prediction may fail and result in huge loss.

## 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 proposed model achieved the highest accuracy as compared to other state-of-the-art methods due to its multilayered structure. The proposed model performs significantly better for natural disaster detection and classification, but in the future the model can be used for various natural disaster detection processes.

## 12. FUTURE SCOPE

The overall proposed model works on an image dataset to detect and classify the natural disasters. As the model is evaluated on a simple central processing unit (CPU)-based system, it only detects disaster types and then classifies them into cyclone, earthquake, flood and wildfire classes.

However, if this model is run on a graphic processing unit **(GPU)-based system** in the future with real time sensors and monitoring power, then the proposed model will be used as a real time natural disaster detection model and provide some upcoming predictions for future disasters.

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.



## 13. APPENDIX:

### Source Code

#### home.html:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css" rel="stylesheet"
integrity="sha384-Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
  <title>Document</title>
</head>
<body>
  <div class="card text-center">
    <div class="card-header">
      <ul class="nav nav-tabs card-header-tabs">
        <li class="nav-item">
          <a class="nav-link active" aria-current="true" href="{{ url_for('home') }}" style="font-size:
24px;">Home</a>
        </li>
        <li class="nav-item">
          <a class="nav-link" href="{{ url_for('intro') }}" style="font-size: 24px;">Introduction</a>
        </li>
        <li class="nav-item">
          <a class="nav-link" href="{{ url_for('upload') }}" style="font-size: 24px;">Upload</a>
        </li>
      </ul>
      <h3 style="float: right;">AI based Natural Disaster Analysis</h3>
    </div>
  </div>
  <div class="container" style="text-align: center;">
    <div class="card" style="width: 18rem; padding: 10px; margin: 40px; margin-left: 40px; display: inline-
block">
      
      <div class="card-body">
        <h5 class="card-title">Cyclone</h5>
      </div>
    </div>
  </div>
</body>
</html>
```

```
<p class="card-text">cyclone, large system of winds that circulates counterclockwise direction north of the Equator and clockwise direction to the south.</p>
```

```
<a href="https://en.wikipedia.org/wiki/Cyclone" class="btn btn-primary">Know more</a>
```

```
</div>
```

```
</div>
```

```
<div class="card" style="width: 18rem; padding: 10px; margin: 40px; margin-left: 40px;display:inline-block">
```

```

```

```
<div class="card-body" >
```

```
<h5 class="card-title">Earthquake</h5>
```

```
<p class="card-text">A sudden violent shaking of the ground, causing great destruction, as a result of movements within the earth's crust.</p>
```

```
<a href="https://en.wikipedia.org/wiki/Earthquake" class="btn btn-primary">Know more</a>
```

```
</div>
```

```
</div>
```

```
</div>
```

```
<div class = "container" style="text-align: center;">
```

```
<div class="card" style="width: 18rem; padding: 10px; margin: 40px; margin-left: 40px;display:inline-block">
```

```

```

```
<div class="card-body" >
```

```
<h5 class="card-title">Flood</h5>
```

```
<p class="card-text">An overflow of a large amount of water beyond its normal limits, especially over what is normally dry land.</p>
```

```
<a href="https://en.wikipedia.org/wiki/Flood" class="btn btn-primary">know more</a>
```

```
</div>
```

```
</div>
```

```
<div class="card" style="width: 18rem; padding: 10px; margin: 40px; margin-left: 40px;display:inline-block">
```

```

```

```
<div class="card-body" >
```

```
<h5 class="card-title">Wild Fire</h5>
```

```
<p class="card-text">A wildfire is an unplanned, uncontrolled and unpredictable fire in an area of combustible vegetation starting in rural and urban areas.</p>
```

```
<a href="https://en.wikipedia.org/wiki/Wildfire" class="btn btn-primary">Know more</a>
```

```
</div>
```

```
</div>
```

```
</div>
```

</body>

</html>

## intro.html:

<!DOCTYPE html>

<html lang="en">

<head>

<meta charset="UTF-8">

<meta http-equiv="X-UA-Compatible" content="IE=edge">

<meta name="viewport" content="width=device-width, initial-scale=1.0">

<link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css" rel="stylesheet" integrity="sha384-Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi" crossorigin="anonymous">

<title>Document</title>

</head>

<body>

<div class="card text-center">

<div class="card-header">

<ul class="nav nav-tabs card-header-tabs">

<li class="nav-item">

<a class="nav-link" aria-current="true" href="{{ url\_for('home') }}" style="font-size: 24px;">Home</a>

</li>

<li class="nav-item">

<a class="nav-link active" href="{{ url\_for('intro') }}" style="font-size: 24px;">Introduction</a>

</li>

<li class="nav-item">

<a class="nav-link" href="{{ url\_for('upload') }}" style="font-size: 24px;">Upload</a>

</li>

</ul>

<h3 style="float: right;">AI based Natural Disaster Analysis</h3>

</div>

</div>

<h2 style="padding: 50px; margin: 50px; word-spacing: 15px; text-align: center ;line-height: 1.6;">

China, India and the United States are among the countries in 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. <br><br> However, whether or not you are likely to be

affected by a natural disaster dramatically 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 webcam, which in turn is given to the pre-trained model. The model predicts the type of disaster and displayed on UI.

```
</h2>
</body>
</html>
```

### **upload.html:**

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css" rel="stylesheet"
integrity="sha384-Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">
  <title>Document</title>
  <style>
    table {
      max-width: 100%;
    }
    tr:nth-child(odd) {
      background-color: #eee;
    }
    th {
      background-color: #555;
      color: #fff;
    }
    th,
    td {
      text-align: left;
      padding: 0.5em 1em;
    }
    .center {
      margin-left: auto;
      margin-right: auto;
```

```

    }
    table, th, td {
        border: 1px solid black;
    }

</style>
</head>
<body>
    <div class="card text-center">
        <div class="card-header">
            <ul class="nav nav-tabs card-header-tabs">
                <li class="nav-item">
                    <a class="nav-link" aria-current="true" href="{{ url_for('home') }}" style="font-size:
24px;">Home</a>
                </li>
                <li class="nav-item">
                    <a class="nav-link" href="{{ url_for('intro') }}" style="font-size: 24px;">Introduction</a>
                </li>
                <li class="nav-item">
                    <a class="nav-link active" href="{{ url_for('upload') }}" style="font-size: 24px;">Upload</a>
                </li>
            </ul>
            <h3 style="float: right;">AI based Natural Disaster Analysis</h3>
        </div>
    </div><br><br><br><br><br>
    <table class="center">
        <tr>
            <th>UPLOAD VIDEO</th>
            <th>LIVE DETECT</th>
        </tr>
        <tr>
            <td>
                <form action="{{ url_for('uploader') }}" method="POST" enctype="multipart/form-data">
                    <input type="file" name="filename" />
                    <input type="submit" value="Submit"/>
                </form>
            </td>
            <td>

```

```


<form action="{{ url_for('livecam') }}" method="POST">
    <input type="submit" value="Open camera"/>
</form>
</td>
</tr>
</table> <br><br><br>
<p style="text-align:center">Enter 'q' to quit</p>
</body>
</html>

```

## Home.html

[Home](#)
[Introduction](#)
[Upload](#)


AI based Natural Disaster Analysis



**Cyclone**

cyclone, large system of winds that circulates counterclockwise direction north of the Equator and clockwise direction to the south.


[Know more](#)



**Earthquake**

A sudden violent shaking of the ground, causing great destruction, as a result of movements within the earth's crust.


[Know more](#)



**Flood**

An overflow of a large amount of water beyond its normal limits, especially over what is normally dry land.

[know more](#)



**Wild Fire**

A wildfire is an unplanned, uncontrolled and unpredictable fire in an area of combustible vegetation starting in rural and urban areas.

[Know more](#)

## Intro.html:

[Home](#) [Introduction](#) [Upload](#)

AI based Natural Disaster Analysis

China, India and the United States are among the countries in 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 dramatically depends on where in the world you live, The

## Upload.html:

[Home](#) [Introduction](#) [Upload](#)

AI based Natural Disaster Analysis

UPLOAD VIDEO

LIVE DETECT

Choose File No file chosen Submit Open camera

Enter 'q' to quit

Pictures

This PC

3D Objects

Desktop

Documents

Downloads

Music

Pictures

Videos

Win10 (C:)

Data 2 (E:)

Network

Name	Status	Date modified
ML Course 1		22-09-2022 14:06
Nalayathiran_old		08-11-2022 13:37
vkj		26-10-2022 21:07
Zoho		29-10-2022 12:35
Algorithms - Shortcut		25-09-2022 10:47
Anaconda Navigator (anaconda3)		28-08-2021 09:44
cyclone		08-11-2022 15:15
Downloads - Shortcut		19-02-2022 14:52
Eclipse IDE for Java Developers - 2021-03		24-07-2021 13:29
Git Bash		24-02-2022 22:09
IBM project - Shortcut		03-10-2022 00:00
IDLE (Python 3.9 64-bit)		10-08-2021 15:00

File name: cyclone All Files Open Cancel

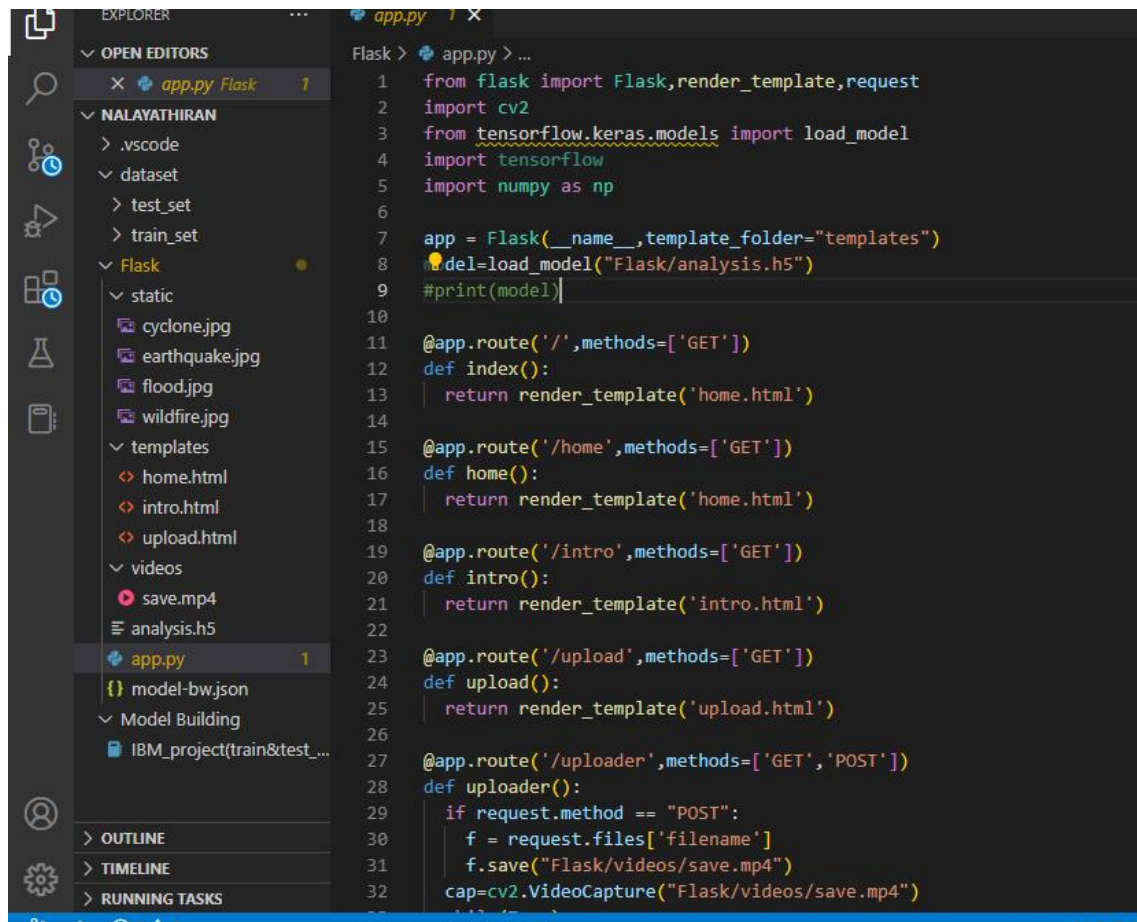
AI based Natural Disaster Analysis

LIVE DETECT

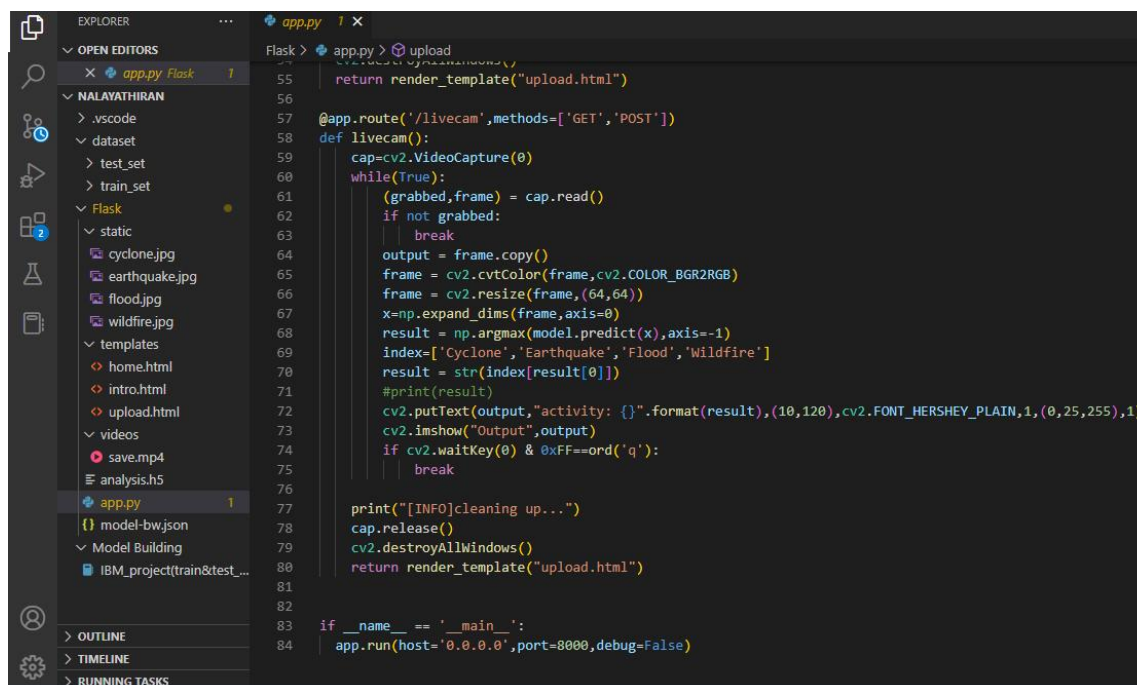
Submit Open camera

Enter 'q' to quit

## Flask(application.py)



```
Flask > app.py > ...
1  from flask import Flask,render_template,request
2  import cv2
3  from tensorflow.keras.models import load_model
4  import tensorflow
5  import numpy as np
6
7  app = Flask(__name__,template_folder="templates")
8  model=load_model("Flask/analysis.h5")
9  #print(model)
10
11 @app.route('/',methods=['GET'])
12 def index():
13     return render_template('home.html')
14
15 @app.route('/home',methods=['GET'])
16 def home():
17     return render_template('home.html')
18
19 @app.route('/intro',methods=['GET'])
20 def intro():
21     return render_template('intro.html')
22
23 @app.route('/upload',methods=['GET'])
24 def upload():
25     return render_template('upload.html')
26
27 @app.route('/uploader',methods=['GET','POST'])
28 def uploader():
29     if request.method == "POST":
30         f = request.files['filename']
31         f.save("Flask/videos/save.mp4")
32         cap=cv2.VideoCapture("Flask/videos/save.mp4")
```



```
Flask > app.py > upload
33     return render_template("upload.html")
34
35 @app.route('/livecam',methods=['GET','POST'])
36 def livecam():
37     cap=cv2.VideoCapture(0)
38     while(True):
39         (grabbed,frame) = cap.read()
40         if not grabbed:
41             break
42         output = frame.copy()
43         frame = cv2.cvtColor(frame,cv2.COLOR_BGR2RGB)
44         frame = cv2.resize(frame,(64,64))
45         x=np.expand_dims(frame,axis=0)
46         result = np.argmax(model.predict(x),axis=-1)
47         index=['Cyclone','Earthquake','Flood','Wildfire']
48         result = str(index[result[0]])
49         #print(result)
50         cv2.putText(output,"activity: {}".format(result),(10,120),cv2.FONT_HERSHEY_PLAIN,1,(0,25,255),1)
51         cv2.imshow("Output",output)
52         if cv2.waitKey(0) & 0xFF==ord('q'):
53             break
54
55     print("[INFO]cleaning up...")
56     cap.release()
57     cv2.destroyAllWindows()
58     return render_template("upload.html")
59
60 if __name__ == '__main__':
61     app.run(host='0.0.0.0',port=8000,debug=False)
```



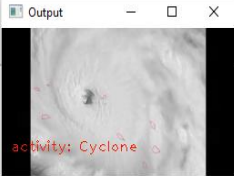
OUTPUT:

[Home](#)[Introduction](#)

Upload

AI based Natural Disaster Analysis

Output



UPLOAD VIDEO

Choose File

cyclone.mp4

Submit

LIVE DETECT

Open camera


Enter 'q' to quit

[Home](#)[Introduction](#)

Upload

AI based Natural Disaster Analysis

Output



UPLOAD VIDEO

Choose File

wildfire.mp4

Submit

LIVE DETECT

Open camera

Enter 'q' to quit

# AI based Natural disaster analysis.ipynb

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
train_datagen = ImageDataGenerator(rescale=1./255, zoom_range=0.2, horizontal_flip=True, shear_range=0.2)
test_datagen = ImageDataGenerator(rescale=1./255)
```

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

Found 742 images belonging to 4 classes.  
Found 198 images belonging to 4 classes.

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

```
model=Sequential()
model.add(Conv2D(32,(3,3),input_shape=(64,64,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Conv2D(32,(3,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())
```

+ Code + Text

```
[ ] model.add(Dense(units=128,activation='relu'))
    model.add(Dense(units=4,activation='softmax'))
    model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

```
[ ] model.summary()
```

Model: "sequential\_1"

Layer (type)	Output Shape	Param #
=====		
conv2d_2 (Conv2D)	(None, 62, 62, 32)	896
max_pooling2d_2 (MaxPooling 2D)	(None, 31, 31, 32)	0
conv2d_3 (Conv2D)	(None, 29, 29, 32)	9248
max_pooling2d_3 (MaxPooling 2D)	(None, 14, 14, 32)	0
flatten_1 (Flatten)	(None, 6272)	0
dense_2 (Dense)	(None, 128)	802944

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

Epoch 1/20
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future
    """Entry point for launching an IPython kernel.
149/149 [=====] - 44s 293ms/step - loss: 1.1635 - accuracy: 0.4798 - val_loss: 0.9364 - val_accuracy: 0.6566
Epoch 2/20
149/149 [=====] - 41s 273ms/step - loss: 0.8416 - accuracy: 0.6429 - val_loss: 0.8283 - val_accuracy: 0.6717
Epoch 3/20
149/149 [=====] - 42s 284ms/step - loss: 0.6678 - accuracy: 0.7655 - val_loss: 0.7795 - val_accuracy: 0.7323
Epoch 4/20
149/149 [=====] - 41s 273ms/step - loss: 0.6775 - accuracy: 0.7493 - val_loss: 0.6493 - val_accuracy: 0.7626
Epoch 5/20
149/149 [=====] - 41s 273ms/step - loss: 0.5995 - accuracy: 0.7749 - val_loss: 0.6781 - val_accuracy: 0.7879
Epoch 6/20
149/149 [=====] - 41s 273ms/step - loss: 0.5397 - accuracy: 0.7817 - val_loss: 0.8131 - val_accuracy: 0.7172
Epoch 7/20
149/149 [=====] - 42s 285ms/step - loss: 0.4696 - accuracy: 0.8275 - val_loss: 0.6780 - val_accuracy: 0.7879
Epoch 8/20
149/149 [=====] - 41s 272ms/step - loss: 0.4959 - accuracy: 0.8194 - val_loss: 0.8018 - val_accuracy: 0.7576
Epoch 9/20
149/149 [=====] - 41s 273ms/step - loss: 0.3969 - accuracy: 0.8544 - val_loss: 0.6865 - val_accuracy: 0.7828
Epoch 10/20
149/149 [=====] - 41s 273ms/step - loss: 0.3885 - accuracy: 0.8652 - val_loss: 0.8218 - val_accuracy: 0.7677
```

```
[ ] x_train=x_train[:1000],x_val=x_val[:1000]

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

▶ img = image.load_img(r"/content/drive/MyDrive/dataset/test_set/Earthquake/1347.jpg",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
index=['Cyclone','Earthquake','Flood','Wildfire']
y=np.argmax(model.predict(x),axis=1)
print(index[int(y)])

1/1 [=====] - 0s 82ms/step
Earthquake

▶ img = image.load_img(r"/content/drive/MyDrive/dataset/test_set/Cyclone/918.jpg",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
index=['Cyclone','Earthquake','Flood','Wildfire']
y=np.argmax(model.predict(x),axis=1)
print(index[int(y)])

1/1 [=====] - 0s 23ms/step
Cyclone
```

## GITHUB LINK:

<https://github.com/IBM-EPBL/IBM-Project-11024-1659254459>

## DEMOLINK:

[https://drive.google.com/file/d/1BUykEheLec-Tug4fUwEnAi5C\\_l3b0zvL/view](https://drive.google.com/file/d/1BUykEheLec-Tug4fUwEnAi5C_l3b0zvL/view)