

TEAM ID	PNT2022TMID06689
TEAM MEMBERS	R.SUWETHA S.PRIYATHARSHINI V.PRADEEPKUMAR M.A.NANDHAKUMAR

Natural Disasters intensity Analysis and classification using Artificial Intelligence

DOCUMENTATION

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1. INTRODUCTION

1.1 Project Overview

Natural disasters not only disturb the human ecological system . Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. 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 purpose of the project is analyse the intensity of the Natural Disasters. Now a days, increase the earth quakes and cyclones, floods, and wildfires. So this application help them to predict the earth quakes, cyclones etc...

2. LITERATURE SURVEY

2.1 Existing Problem

AI can help response teams understand natural hazards, monitor events in real time, and anticipate specific risks in the face of impending or on-going disasters. "The more early warning we have, the more prepared we are, and the less will be the humanitarian tragedy", said Muralee Thummarukudy, Operations Manager at the Crisis Management Branch of the United Nations Environment Programme (UNEP).

2.2 References

https://www.researchgate.net/publication/350830884_Natural_Disasters_Intensity_Analysis_and_Classification_Based_on_Multispectral_Images_Using_Multi-Layered_Deep_Convolutional_Neural_Network

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2. Ideation & Brainstorming

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions as 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 brainstorm
- 1-2 people (recommended)

[View template \(download\)](#)

1 Prepare

Who you collaborate

At least 10 of preparation goes in only with this session. Hence what you need to do to get going.

10 minutes

1 **Brainstorming**
 Brainstorm ideas participants in the session and select an idea. Share research information or previous ideas.

2 **Set the goal**
 The session goal (what you're looking for) is to brainstorm ideas.

3 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

[View template \(download\)](#)

2 Define

Define your problem statement

What problem are you trying to solve? Frame your problem as a clear, tight problem statement. This will be the focus of your brainstorm.

10 minutes

1 **Problem**
 What is the problem you're trying to solve?

2 **Facilitator Subgroup**
 Use the Facilitator Subgroup to set a topic and generate ideas.

3 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

[View template \(download\)](#)

3 Brainstorm

What about the ideas that come to mind that address your problem statement?

10 minutes

1 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

2 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

3 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

[View template \(download\)](#)

4 Prioritize

What about the ideas that come to mind that address your problem statement?

10 minutes

1 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

2 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

3 **Brainstorm**
 Use the Facilitator Subgroup to set a topic and generate ideas.

[View template \(download\)](#)

Brainstorm

Ⓢ 90 minutes



Group Ideas

Ⓢ 30 minutes

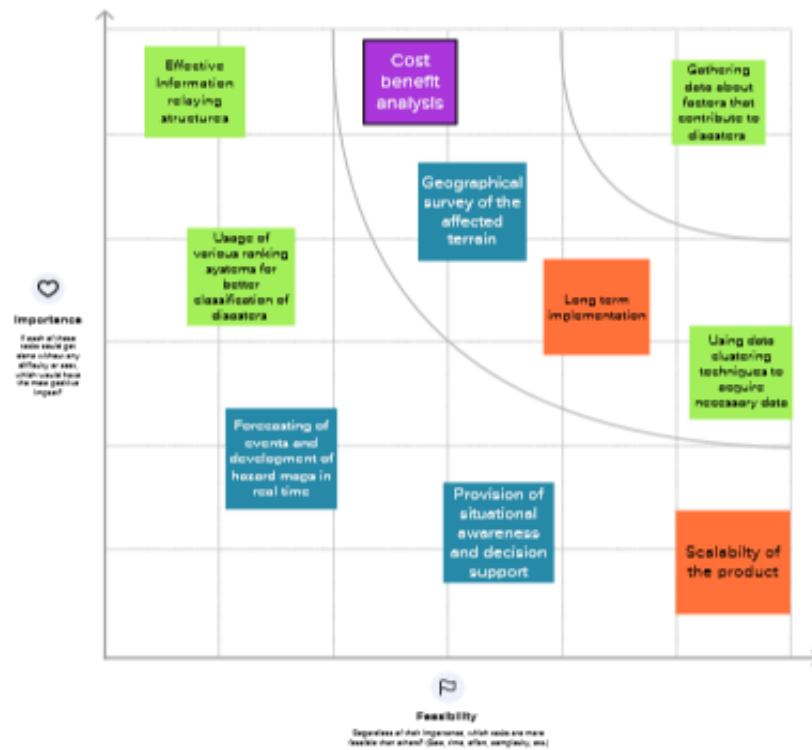




Prioritize

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

30 minutes



After you collaborate

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

Quick add-ons

- Share the mural!**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- Export the mural**
Export a copy of the mural as a PNG or PDF to share to email, include in slides, or save to your drive.

Keep moving forward

- Strategy blueprint**
Define the components of a new idea or strategy.
[Open the template](#)
- Customer experience journey map**
Understand customer needs, motivations, and obstacles for an experience.
[Open the template](#)
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
[Open the template](#)

[Share template feedback](#)



3.3 Proposed Solution

Proposed Solution Template:

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

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To monitor and predict the disasters and its intensity of impacts on the region.
2.	Idea/Solution description	To use classification algorithm to identify the impacts of disaster.
3.	Novelty/Uniqueness	Usage of reinforcement learning algorithm to let the AI be self-sufficient and capable of gathering essential data on its own for prediction.
4.	Social Impact/Customer Satisfaction	This product will help in making crucial decisions support at times of emergencies and also raise fundamental awareness of the impacts of disasters.
5.	Business Model (Revenue Model)	Revenue generated through Royalty payments, product license costs in department, research and educational platforms.
6.	Scalability of the Solution	Disintegration of geographical terrains into multiple provinces which can be interconnected as a grid to help alleviate its scale.

3.4 Proposed Solution fit

Define CS, fit into CC	<p>1. CUSTOMER SEGMENT(S) CS</p> <p>Who is your customer? i.e. working parents of 0-5 yrs. kids</p> <p>Seismologist Volcanologist Meteorologist Oceanographer Climatologist</p>	<p>6. CUSTOMER CONSTRAINTS CC</p> <p>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available services.</p> <p>Scope of the product. Cost. Prolonged periods of implementation. Environmental constraints. Lack of sufficient resources. Varying geographical terrain. Unpredictable climate changes.</p>	<p>5. AVAILABLE SOLUTIONS AS</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 price & costs do these solutions have? i.e. pen and paper is an alternative to digital networking.</p> <p>Usage of classification algorithm solely for the purpose of identification for impacts of disasters by the help of optimized data clustering.</p> <p>Pros:</p> <ol style="list-style-type: none"> 1) Model transparency 2) Clear distinction between indirect and direct efforts 3) Well-suited to short-term recovery periods <p>Cons:</p> <ol style="list-style-type: none"> 1) Ignores other fundamental factors responsible for such phenomenon 2) Lack of scalability of the product 	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	<p>2. JOBS-TO-BE-DONE / PROBLEMS J&P</p> <p>Which jobs to be done (or problems) do you address for your customers? There could be more than one; explore different roles.</p> <p>It is difficult to analyze factors such as atmospheric pressure, tectonic movements, ocean surface disturbances and volcanic activity which results in such devastating phenomenon.</p>	<p>9. PROBLEM ROOT CAUSE RC</p> <p>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</p> <ol style="list-style-type: none"> 1) Natural phenomenon 2) Influence of stellar objects 3) Tectonic movement 4) Soil erosion 5) Deforestation 6) Ocean currents 7) Air pressure 8) Seismic waves 	<p>7. BEHAVIOUR BE</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 less time on volunteering work (i.e. Greenpeace)</p> <ol style="list-style-type: none"> 1) Develops, adopts, and enforces building codes and land-use standards. 2) Requires construction of disaster-resistant structures. 3) By providing training and professional development programs. 4) Coordinating incident response planning. 	Focus on J&P, tap into BE, understand RC
Identify strong TR & EM	<p>3. TRIGGERS TR</p> <p>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</p> <p>When a product offers high precision for such unpredictable factors, it encourages the users to obtain it at all costs.</p> <p>4. EMOTIONS: BEFORE / AFTER EM</p> <p>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure > confident, in control - use it in your communication strategy & design.</p> <p>Due to the variables present in the data gathered from the surroundings, many people tend to be confused and frustrated at the lack of results. However, since this product provides high yield of results, it not only raises their overall work efficiency but also their confidence.</p>	<p>10. YOUR SOLUTION SOL</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, solves a problem and matches customer behaviour.</p> <p>We hope to integrate the supervised classification algorithm with the reinforcement learning algorithm to help the AI monitor and predict the influence of various factors in the environment and their impacts.</p>	<p>8. CHANNELS of BEHAVIOUR CH</p> <ol style="list-style-type: none"> 1. ONLINE What kind of actions do customers take online? Extract online channels from #7 2. OFFLINE What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development. <p>ONLINE:</p> <ol style="list-style-type: none"> 1) They seek technical support or the experts opinion on such matters via internet. 2) They organize strategical meetings with other authoritarians to help in decision making. <p>OFFLINE:</p> <ol style="list-style-type: none"> 1) They involve in a series of planning activities to ensure the smooth progress of the monitoring and preventing the impacts of the natural phenomenon. 	Identify strong TR & EM

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	User Registration	Register through mobile application Call the given emergency number
FR-2	User Confirmation	Confirmation via Call back Confirmation via Text
FR-3	User Preparation	Ensure safety of all people Supply of canned food
FR-4	User evacuation	Waiting for evacuation team Take refuge in nearest safe location

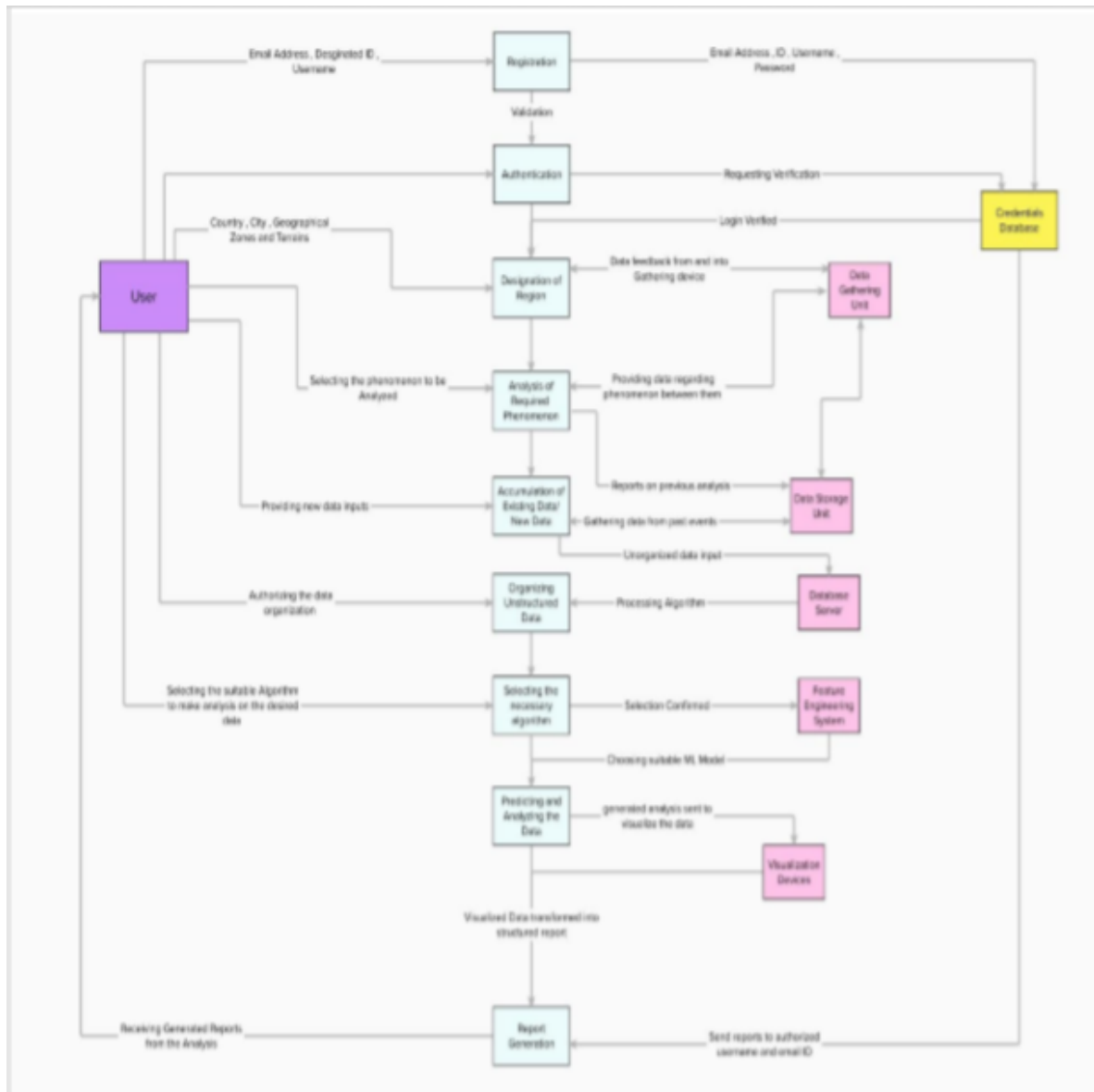
4.2 Non-Functional requirements

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

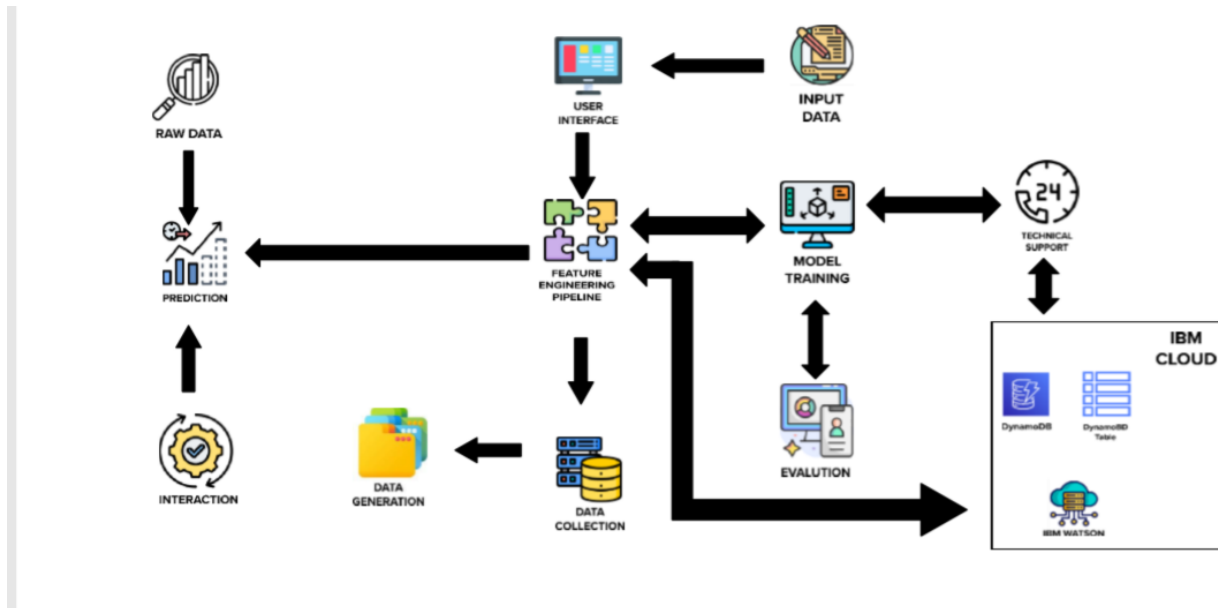
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	It is easy and quick method to predict the disasters.
NFR-2	Security	The secure pattern shares components with monitor and control for logging and control access and for providing audit trails.
NFR-3	Reliability	It should be highly reliable.
NFR-4	Performance	It deals with the measure of the system's response time.
NFR-5	Availability	It can be available at any time and we can access during any disasters.
NFR-6	Scalability	Disaster damages are measured involves examining the number of fatalities, of injuries, of people affected.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories

UserStories:

User Type	Functional Requirement(Epic)	User Story Number(USN)	User Story/Task	Acceptance criteria	Priority	Release
Enduser (Customer)	Registration	USN-1	As a user, I am able to register with the product using my valid email address	I should be able to register with my account credentials	High	Sprint-1
EndUser (Customer)	Authentication	USN-2	As a user, I am able to login into the system with my credentials	It should ensure smooth login capabilities without delay	High	Sprint-1
EndUser (Customer)	Designation of Region	USN-3	I can select the region of interest to be monitored and analyzed	I must be able to choose certain specific places without error	High	Sprint-1

EndUser (Customer)	Analysis ofRequiredP henomenon	USN-4	I am able to monitorcertain factors thatinfluence the actions ofthephenomenon	Itshouldconsidera nd monitor mostof the factorsinvolved in theaction	High	Sprint-2
EndUser (Customer)	Accumulation of requiredData	USN-5	I am able to gatherdata regarding pastevents and a detailedreportonpasta nalysis	It should allow thestorage of data ofpast events forcertainextent	Medium	Sprint-2
EndUser (Customer)	OrganizingU nstructuredd ata	USN-6	I am able to organizeand restructure theraw data into refineddata	It should ensureeasyandef ficientprocessing methods	Low	Sprint-3
EndUser (Customer)	Algorithm selection	USN-7	I am able to choosetherequiredalg orithmforaspecificanal ysis	It must providevarious options forthealgorithmto beused	High	Sprint-2
EndUser (Customer)	Prediction andanalysisofd ata	USN-8	I am able to easilypredictandvisu alizethedata	Itshouldalloweasyto use predictionand visualizationtechniq ues	High	Sprint-3
EndUser (Customer)	Reportgen eration	USN-9	I am able to generatea clear and detailedreportonthea nalysis	Report generationmust be fast andefficientandsho uldnotbecomplex	Medium	Sprint-4

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

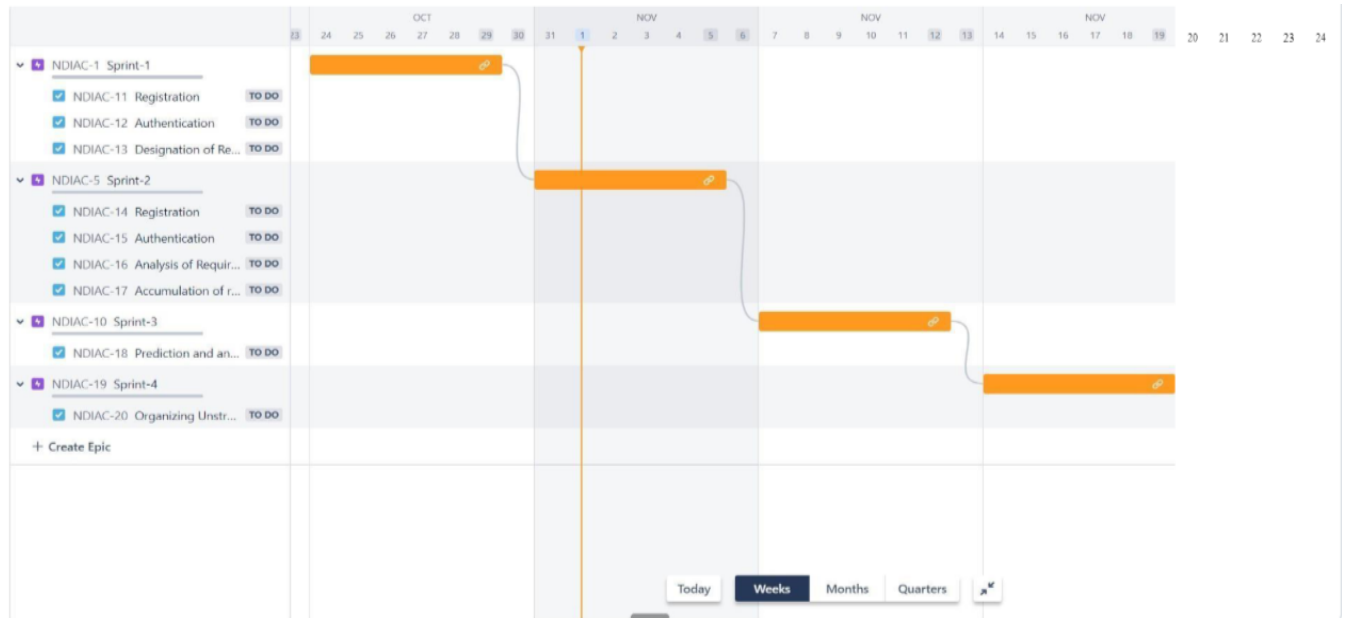
Sprint	FunctionalRe quirement(E pic)	Usersto ryNumb er	Userstory/ Task	Story points	Priority	Teammembers
Sprint-1	Registration	USN-1	As a user, registering into the product using a valid email address	5	High	Priyatharshini S
Sprint-2	Registration	USN-2	As a user, registering into the product using a valid username and password	3	Medium	Nandha Kumar M A & Suwetha R
Sprint-1	Authentication	USN-3	As a user, I am adept to logging into the system with credentials	4	High	Priyatharshini S
Sprint-2	Authentication	USN-4	As a user, I am adept to logging into the system with OTP	2	High	Nandha Kumar M A
Sprint-1	Designation of Region	USN-5	selecting the region of interest to be moni tored and analysed	3	High	Priyatharshini S
Sprint-2	Analysis of Required P henomenon	USN-6	Regulating certain factors influencing the actions of the phenomenon	3	High	Nandha Kumar M A & Pradeepkumar V

Sprint	Functional Requirement (Epic)	User Story Number	User Story/ Task	Story points	Priority	Team members
Sprint-2	Accumulation of required Data	USN-7	Gathering data and detailed report on past event analysis	3	Low	Nandha Kumar M A
Sprint-4	Organizing Unstructured data	USN-8	Choosing a required algorithm for specific analysis	2	High	Pradeepkumar V
Sprint-2	Algorithm selection	USN-9	Choosing a required algorithm for specific analysis	6	High	Nandha Kumar M A & Suwetha R
Sprint-3	Prediction and analysis of data	USN-10	Predicting and visualizing the data effectively	36	High	Suwetha R
Sprint-4	Report generation	USN-11	Generating a clear and detailed report on product data analysis	3	High	Pradeepkumar V

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	12	6 days	24 Oct 2022	29 Oct 2022	12	30 Oct 2022
Sprint-2	14	6 days	31 Oct 2022	5 Nov 2022	14	6 Nov 2022
Sprint-3	6	6 days	04 Nov 2022	9 Nov 2022	6	8 Nov 2022
Sprint-4	6	6 days	4 Nov 2022	9 Nov 2022	6	10 Nov 2022

6.3 Reports from JIRA



7. CODING & SOLUTION

7.1 Feature 1

Created a GUI based interface for the easy interaction of the user using the HTML, CSS, Python Flask. Code in Appendix

7.2 Feature 2

implementation of the Model integrated with HTML and CSS in Appendix

8. TESTING

8.1 Test Cases

Input dataset:

```
Archive: /content/dataset.zip
  inflating: dataset/readme.txt
   creating: dataset/test_set/
   creating: dataset/test_set/Cyclone/
  inflating: dataset/test_set/Cyclone/867.jpg
  inflating: dataset/test_set/Cyclone/868.jpg
  inflating: dataset/test_set/Cyclone/869.jpg
  inflating: dataset/test_set/Cyclone/870.jpg
  inflating: dataset/test_set/Cyclone/871.jpg
  inflating: dataset/test_set/Cyclone/872.jpg
  inflating: dataset/test_set/Cyclone/873.jpg
  inflating: dataset/test_set/Cyclone/874.jpg
  inflating: dataset/test_set/Cyclone/875.jpg
  inflating: dataset/test_set/Cyclone/876.jpg
  inflating: dataset/test_set/Cyclone/877.jpg
  inflating: dataset/test_set/Cyclone/878.jpg
  inflating: dataset/test_set/Cyclone/879.jpg
  inflating: dataset/test_set/Cyclone/880.jpg
  inflating: dataset/test_set/Cyclone/881.jpg
  inflating: dataset/test_set/Cyclone/882.jpg
  inflating: dataset/test_set/Cyclone/883.jpg
  inflating: dataset/test_set/Cyclone/884.jpg
  inflating: dataset/test_set/Cyclone/885.jpg
  inflating: dataset/test_set/Cyclone/886.jpg
  inflating: dataset/test_set/Cyclone/887.jpg
```



```
creating: dataset/test_set/Earthquake/  
inflating: dataset/test_set/Earthquake/1321.jpg  
inflating: dataset/test_set/Earthquake/1322.jpg  
inflating: dataset/test_set/Earthquake/1323.jpg  
inflating: dataset/test_set/Earthquake/1324.jpg  
inflating: dataset/test_set/Earthquake/1325.jpg  
inflating: dataset/test_set/Earthquake/1326.jpg  
inflating: dataset/test_set/Earthquake/1327.jpg  
inflating: dataset/test_set/Earthquake/1328.jpg  
inflating: dataset/test_set/Earthquake/1329.jpg  
inflating: dataset/test_set/Earthquake/1330.jpg  
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inflating: dataset/test_set/Earthquake/1334.jpg  
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inflating: dataset/test_set/Earthquake/1342.jpg  
inflating: dataset/test_set/Earthquake/1343.jpg  
inflating: dataset/test_set/Earthquake/1344.jpg  
inflating: dataset/test_set/Earthquake/1345.jpg  
inflating: dataset/test_set/Earthquake/1346.jpg  
inflating: dataset/test_set/Earthquake/1347.jpg  
inflating: dataset/test_set/Earthquake/1348.jpg  
inflating: dataset/test_set/Earthquake/1349.jpg
```

creating: dataset/test_set/Flood/
inflating: dataset/test_set/Flood/1000.jpg
inflating: dataset/test_set/Flood/1001.jpg
inflating: dataset/test_set/Flood/1002.jpg
inflating: dataset/test_set/Flood/1003.jpg
inflating: dataset/test_set/Flood/1004.jpg
inflating: dataset/test_set/Flood/1005.jpg
inflating: dataset/test_set/Flood/1006.jpg
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inflating: dataset/test_set/Flood/1020.jpg
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inflating: dataset/test_set/Flood/1022.jpg
inflating: dataset/test_set/Flood/1023.jpg
inflating: dataset/test_set/Flood/1024.jpg
inflating: dataset/test_set/Flood/1025.jpg
inflating: dataset/test_set/Flood/1026.jpg
inflating: dataset/test_set/Flood/1027.jpg
inflating: dataset/test_set/Flood/1028.jpg

inflating: dataset/test_set/Flood/999.jpg
creating: dataset/test_set/Wildfire/
inflating: dataset/test_set/Wildfire/1035.jpg
inflating: dataset/test_set/Wildfire/1036.jpg
inflating: dataset/test_set/Wildfire/1037.jpg
inflating: dataset/test_set/Wildfire/1038.jpg
inflating: dataset/test_set/Wildfire/1039.jpg
inflating: dataset/test_set/Wildfire/1040.jpg
inflating: dataset/test_set/Wildfire/1041.jpg
inflating: dataset/test_set/Wildfire/1042.jpg
inflating: dataset/test_set/Wildfire/1043.jpg
inflating: dataset/test_set/Wildfire/1044.jpg
inflating: dataset/test_set/Wildfire/1045.jpg
inflating: dataset/test_set/Wildfire/1046.jpg
inflating: dataset/test_set/Wildfire/1047.jpg
inflating: dataset/test_set/Wildfire/1048.jpg
inflating: dataset/test_set/Wildfire/1049.jpg
inflating: dataset/test_set/Wildfire/1050.jpg
inflating: dataset/test_set/Wildfire/1051.jpg
inflating: dataset/test_set/Wildfire/1052.jpg
inflating: dataset/test_set/Wildfire/1053.jpg
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inflating: dataset/test_set/Wildfire/1057.jpg
inflating: dataset/test_set/Wildfire/1058.jpg
inflating: dataset/test_set/Wildfire/1059.jpg
inflating: dataset/test_set/Wildfire/1060.jpg
inflating: dataset/test_set/Wildfire/1061.jpg
inflating: dataset/test_set/Wildfire/1062.jpg
inflating: dataset/test_set/Wildfire/1063.jpg

Predicted Output:

```
Epoch 1/20
149/149 [=====] - 42s 272ms/step - loss: 1.1632 - accuracy: 0.5216 - val_loss: 0.9812 - val_accuracy: 0.5354
Epoch 2/20
149/149 [=====] - 38s 252ms/step - loss: 0.8483 - accuracy: 0.6712 - val_loss: 0.7859 - val_accuracy: 0.7374
Epoch 3/20
149/149 [=====] - 39s 263ms/step - loss: 0.6883 - accuracy: 0.7278 - val_loss: 0.8899 - val_accuracy: 0.6970
Epoch 4/20
149/149 [=====] - 41s 279ms/step - loss: 0.6571 - accuracy: 0.7170 - val_loss: 1.0388 - val_accuracy: 0.6111
Epoch 5/20
149/149 [=====] - 38s 253ms/step - loss: 0.5828 - accuracy: 0.7655 - val_loss: 0.7886 - val_accuracy: 0.7525
Epoch 6/20
149/149 [=====] - 39s 265ms/step - loss: 0.5124 - accuracy: 0.8113 - val_loss: 0.9449 - val_accuracy: 0.6616
Epoch 7/20
149/149 [=====] - 38s 252ms/step - loss: 0.4475 - accuracy: 0.8208 - val_loss: 0.9295 - val_accuracy: 0.7626
Epoch 8/20
149/149 [=====] - 37s 253ms/step - loss: 0.5198 - accuracy: 0.8208 - val_loss: 1.0729 - val_accuracy: 0.7172
Epoch 9/20
149/149 [=====] - 39s 261ms/step - loss: 0.4103 - accuracy: 0.8423 - val_loss: 1.0310 - val_accuracy: 0.6768
Epoch 10/20
149/149 [=====] - 42s 280ms/step - loss: 0.4223 - accuracy: 0.8491 - val_loss: 0.7108 - val_accuracy: 0.7929
Epoch 11/20
149/149 [=====] - 38s 254ms/step - loss: 0.4170 - accuracy: 0.8544 - val_loss: 0.8419 - val_accuracy: 0.7121
Epoch 12/20
149/149 [=====] - 40s 268ms/step - loss: 0.3207 - accuracy: 0.8841 - val_loss: 0.7221 - val_accuracy: 0.8030
Epoch 13/20
149/149 [=====] - 38s 249ms/step - loss: 0.3373 - accuracy: 0.8585 - val_loss: 0.9803 - val_accuracy: 0.7525
Epoch 14/20
149/149 [=====] - 43s 287ms/step - loss: 0.3147 - accuracy: 0.8922 - val_loss: 1.3861 - val_accuracy: 0.6667
Epoch 15/20
149/149 [=====] - 40s 267ms/step - loss: 0.2967 - accuracy: 0.8841 - val_loss: 1.0562 - val_accuracy: 0.7626
Epoch 16/20
149/149 [=====] - 39s 261ms/step - loss: 0.2683 - accuracy: 0.9003 - val_loss: 0.9182 - val_accuracy: 0.8182
```

9. RESULTS

9.1 Performance Metrics

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 62, 62, 32)	896
max_pooling2d (MaxPooling2D)	(None, 31, 31, 32)	0
conv2d_1 (Conv2D)	(None, 29, 29, 32)	9248
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 32)	0
flatten (Flatten)	(None, 6272)	0
dense (Dense)	(None, 128)	802944
dense_1 (Dense)	(None, 4)	516
Total params: 813,604		
Trainable params: 813,604		
Non-trainable params: 0		

10. ADVANTAGES & DISADVANTAGES

Advantages

- Simplicity.
- Provides transparent view of the economy.
- Well suited to short-term recovery periods.

Disadvantages

- Rigidity due to linearity.
- Inadequately deals with monetary interventions.
- Ignores agent behavioural response to disaster.

11.CONCLUSION

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

12.FUTURE SCOPE

Aerial Photography and Remote Sensing.
Information Management.
Refugee Assistance Models.
Prevention and Mitigation Tools,Preparedness Tools.
Victims,Relief Systems.

13. APPENDIX

Source Code

```
1  <!DOCTYPE html>
2  <html lang="en">
3  <title>Home - Natural Disasters Database</title>
4  <meta charset="UTF-8">
5  <meta name="viewport" content="width=device-width, initial-scale=1">
6  <link rel="stylesheet" href="https://www.w3schools.com/w3css/4/w3.css">
7  <link rel="stylesheet" href="https://fonts.googleapis.com/css?family=Lato">
8  <link rel="stylesheet" href="https://fonts.googleapis.com/css?family=Montserrat">
9  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css">
10 <style>
11 Body,h1,h2,h3,h4,h5,h6 {font-family: "Lato", sans-serif}
12 .w3-bar,h1,button {font-family: "Montserrat", sans-serif}
13 .fa-anchor,.fa-coffee {font-size:200px}
14 </style>
15 <body>
16 <!--Navbar ?
17 <div class="w3-top">
18   <div class="w3-bar w3-black w3-card w3-left-align w3-large">
19     <a class="w3-bar-item w3-button w3-hide-medium w3-hide-large w3-right w3-padding-large w3-hover-white w3-large w3-red" href="javascript:void(0);" onclick="myFunction()">
20     <a href="{% url 'home' %}" class="w3-bar-item w3-button w3-hide-small w3-padding-large w3-hover-white">Home</a>
21     <a class="w3-bar-item w3-button w3-padding-large w3-white">Earthquake</a>
22     <a href="{% url 'tsunami' %}" class="w3-bar-item w3-button w3-hide-small w3-padding-large w3-hover-white">Tsunami</a>
23     <a href="{% url 'tornado' %}" class="w3-bar-item w3-button w3-hide-small w3-padding-large w3-hover-white">Tornado</a>
24     <a href="{% url 'volcano' %}" class="w3-bar-item w3-button w3-hide-small w3-padding-large w3-hover-white">Volcanic Activity</a>
25   </div>
26   <!--Navbar on small screens ?
27   <div id="navDemo" class="w3-bar-block w3-white w3-hide w3-hide-large w3-hide-medium w3-large">
28     <a href="#" class="w3-bar-item w3-button w3-padding-large">Earthquake</a>
29     <a href="#" class="w3-bar-item w3-button w3-padding-large">Tsunami</a>
30     <a href="#" class="w3-bar-item w3-button w3-padding-large">Tornado</a>
31     <a href="#" class="w3-bar-item w3-button w3-padding-large">Volcanic Activity</a>
32   </div>
33 </div>
34 <!--Header ?
35 <header class="w3-container w3-grey w3-center" style="padding:128px 16px">
36   <h1 class="w3-margin w3-jumbo">Earthquakes</h1>
37   <p class="w3-xlarge">Natural Disasters Database</p>
38 </header>
39 <div class="w3-container">
40   <h2>Earthquakes</h2>
41   <table class="w3-table-all">
42     <tr>
43       <th>Earthquake_id</th>
44       <th>Intensity</th>
45       <th>Date</th>
46       <th>Country</th>
47       <th>Place</th>
```

```

48     <th>Latitude</th>
49     <th>Longitude</th>
50     {% for quake in all_quakes %}
51     <tr>
52         <td>{{quake.earthquake_id}}</td>
53         <td>{{quake.intensity}}</td>
54         <td>{{quake.date}}</td>
55         <td>{{quake.country}}</td>
56         <td>{{quake.place}}</td>
57         <td>{{quake.latitude}}</td>
58         <td>{{quake.longitude}}</td>
59     </tr>
60     {% endfor %}
61 </table>
62 </div>
63 <div class="w3-container">
64     <h2>Damage caused by the quakes</h2>
65     <table class="w3-table-all">
66         <tr>
67             <th>Earthquake_id</th>
68             <th>Amount (in million)</th>
69             <th>Deaths (in thousands)</th>
70             <th>House_destroyed (in thousands)</th>
71         </tr>
72         {% for d in damage %}
73         <tr>

```

```

75         <td>{{d.amount}}</td>
76         <td>{{d.deaths}}</td>
77         <td>{{d.house_destroyed}}</td>
78     </tr>
79     {% endfor %}
80
81 </table>
82 </div>
83
84 <div class="w3-container w3-black w3-center w3-opacity w3-padding-50">
85     <h1 class="w3-margin w3-xlarge">Thanks for visiting the website</h1>
86 </div>
87
88 <!--Footer ?
89 <footer class="w3-container w3-padding-40 w3-center w3-opacity">
90     <div class="w3-xlarge w3-padding-20">
91         <h1>A Database project </h1>
92 </footer>
93
94 <script>
95 // Used to toggle the menu on small screens when clicking on the menu button
96 Function myFunction() {
97     Var x = document.getElementById("navDemo");
98     If (x.className.indexOf("w3-show") == -1) {
99         x.className += " w3-show";
100     } else {

```

Python Code

```
1  from flask import Flask, render_template, flash, request, session, send_file
2  from flask import render_template, redirect, url_for, request
3  import warnings
4  import datetime
5  import cv2
6
7
8
9  app = Flask(__name__)
10 app.config['DEBUG']
11 app.config['SECRET_KEY'] = '7d441f27d441f27567d441f2b6176a'
12
13 @app.route("/")
14 def homepage():
15
16     return render_template('index.html')
17
18
19
20 @app.route("/Training")
21 def Training():
22     return render_template('Tranning.html')
23
24 @app.route("/Test")
25 def Test():
26     return render_template('Test.html')
```

```
26     return render_template('Test.html')
27
28
29
30
31 @app.route("/train", methods=['GET', 'POST'])
32 def train():
33     if request.method == 'POST':
34         import model as model
35
36         return render_template('Tranning.html')
37
38
39
40
41
42 @app.route("/testimage", methods=['GET', 'POST'])
43 def testimage():
44     if request.method == 'POST':
45
46
47         file = request.files['fileupload']
48         file.save('static/Out/Test.jpg')
49
50         img = cv2.imread('static/Out/Test.jpg')
51         if img is None:
```

```
52         print('no data')
53
54     img1 = cv2.imread('static/Out/Test.jpg')
55     print(img.shape)
56     img = cv2.resize(img, ((int)(img.shape[1] / 5), (int)(img.shape[0] / 5)))
57     original = img.copy()
58     neworiginal = img.copy()
59     cv2.imshow('original', img1)
60     gray = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
61
62     img1S = cv2.resize(img1, (960, 540))
63
64     cv2.imshow('Original image', img1S)
65     grayS = cv2.resize(gray, (960, 540))
66     cv2.imshow('Gray image', grayS)
67
68     gry = 'static/Out/gry.jpg'
69
70     cv2.imwrite(gry, grayS)
71     from PIL import ImageOps, Image
72
73     im = Image.open(file)
74
75     im_invert = ImageOps.invert(im)
76     inv = 'static/Out/inv.jpg'
77     im_invert.save(inv, quality=95)
```

```
78
79     dst = cv2.fastNlMeansDenoisingColored(img1, None, 10, 10, 7, 21)
80     cv2.imshow("Nisie Removal", dst)
81     noi = 'static/Out/noi.jpg'
82
83     cv2.imwrite(noi, dst)
84
85     import warnings
86     warnings.filterwarnings('ignore')
87
88     import tensorflow as tf
89     classifierLoad = tf.keras.models.load_model('firemodel.h5')
90
91     import numpy as np
92     from keras.preprocessing import image
93
94     test_image = image.load_img('static/Out/Test.jpg', target_size=(200, 200))
95     img1 = cv2.imread('static/Out/Test.jpg')
96     # test_image = image.img_to_array(test_image)
97     test_image = np.expand_dims(test_image, axis=0)
98     result = classifierLoad.predict(test_image)
99
100     out = ''
101     pre = ''
102     if result[0][0] == 1:
103
```

```
103         out = "Cyclone"
104
105
106     elif result[0][1] == 1:
107
108         out = "Earthquake"
109
110     elif result[0][2] == 1:
111
112         out = "Flood"
113
114     elif result[0][3] == 1:
115
116         out = "Wildfire"
117
118
119     org = 'static/Out/Test.jpg'
120     gry = 'static/Out/gry.jpg'
121     inv = 'static/Out/inv.jpg'
122     noi = 'static/Out/noi.jpg'
123
124
125
126
127     return render_template('Test.html',result=out,org=org,gry=gry,inv=inv,noi=noi)
128
```

Github Link:

<https://github.com/IBM-EPBL/IBM-Project-30201-1660141771>

Demo video Link:

<https://youtu.be/rKqshUaYmcs>