Natural Disasters Intensity Analysis And Classification Using Artificial Intelligence

Project Report

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Index

1. Introduction

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.

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 convolution 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

As the technologies are continuously improving, aviation systems have begun adopting smart technologies to develop unmanned aerial vehicles (UAVs) equipped with cameras, which can reach distant areas to identify aftereffects of natural disasters on human life, infrastructure, and transmission lines by capturing images and videos. Data acquired from these UAVs helps to identify the facial expressions of victims, the intensity of their situation and their needs in a post disaster scenario. It helps to take actions and carry out necessary operations to tackle devastating scenarios. Raw images obtained from camera-equipped UAVs are processed and neural network-based feature extraction techniques are applied to analyze the intensity.

A deep learning method for the reconstruction of two-dimensional cardiac magnetic resonance images was proposed to enhance the image data acquisition process. Cascade deep convolutional neural networks use a 10-fold method to reconstruct the feature map for the MR images. In this way, feature extraction sequence becomes very fast and it takes less than 5 to 10 s to extract the feature matrix

2. LITERATURE SURVEY

2.1 Existing problem

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.

Keywords: Natural Disaster, Losses, Ecosystems, CNN, OpenCV.

2.2 References

1. Tonini M., D'Andrea M., Biondi G., Degli Esposti S., Trucchia A., Fiorucci P. A Machine Learning-Based Approach forWildfire Susceptibility Mapping. The Case Study of the Liguria Region in Italy.
2. Amit S.N.K.B., Aoki Y. Disaster detection from aerial imagery with convolutional neural network; Proceedings of the2017 International Electronics Symposium on Knowledge Creation and Intelligent Computing (IES-KCIC); Surabaya,Indonesia.
3. Padmawar P.M., Shinde A.S., Sayyed T.Z., Shinde S.K., Moholkar K. Disaster Prediction System using Convolution NeuralNetwork; Proceedings of the 2019 International Conference on Communication and Electronics Systems (ICCES);Coimbatore, India.
4. Nguyen D.T., Ofli F., Imran M., Mitra P. Damage assessment from social media imagery data during disasters;Proceedings of the 2017 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining; Sydney,NSW, Australia.
5. D. Han, L. Chan, and N. Zhu, ``Flood forecasting using support vector machines"
6. X. H. Le, H. V. Ho, G. Lee, and S. Jung, ``Application of long short-term memory (LSTM) neural network for flood forecasting"
7. M. F. Piñeros, E. A. Ritchie, and J. S. Tyo, "Estimating tropical cyclone intensity from infrared image data"
8. T. L. Olander and C. S. Velden, "Tropical cyclone convection and intensity analysis using differenced infrared and water vapor imagery".
9. X. Shi et al., "Deep learning for precipitation nowcasting: A benchmark and a new model"

2.3 Problem Statement Definition

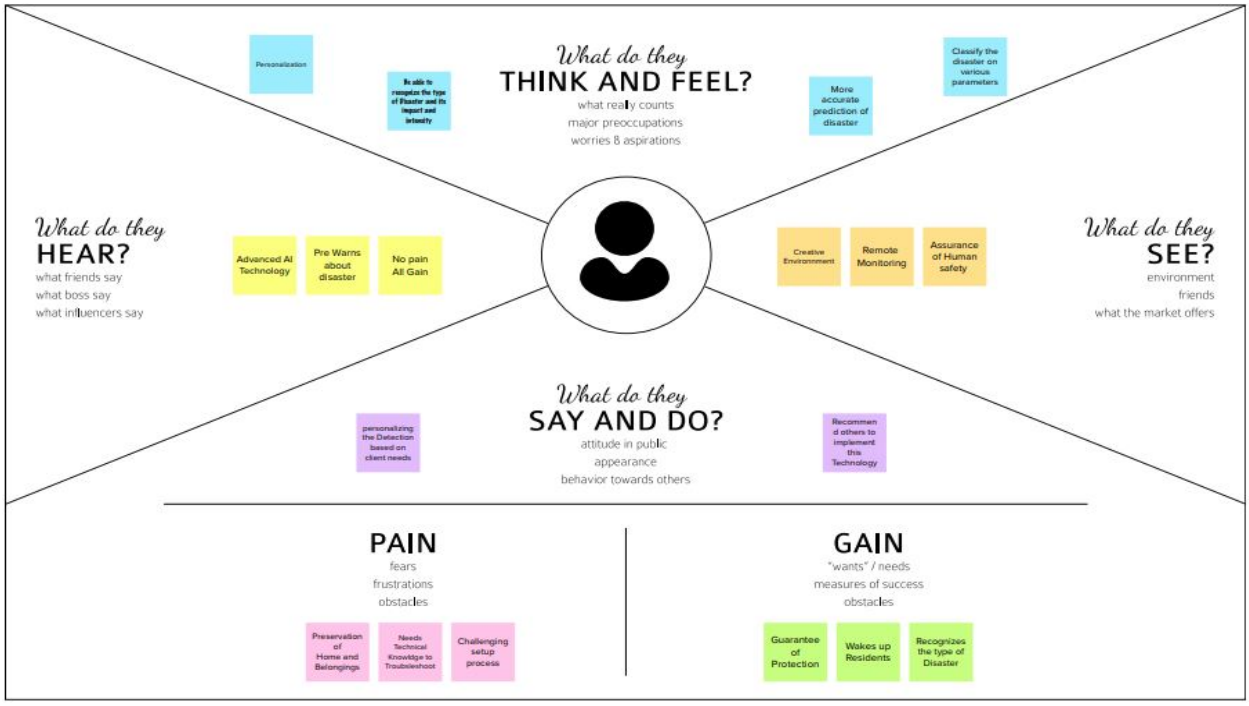
S. No	Paper Title	Idea	Advantages	Disadvantages
1.	Natural Disasters Intensity Analysis and Classification Based on Multispectral ImagesUsing Multi-LayeredDeep Convolutional Neural Network	Block-I convolutional neural network (B-I CNN),for detection andoccurrence of disastersBlock-II convolutional neural network (B-II CNN), for classification of natural disaster intensity types with different filters and parameters.	Easier and accurate calculation of Multispectral images	Takes time since it deals with a lot of images.
2.	Tropical Cyclone Intensity Estimation Using Multidimensional Convolutional Neural Network From Multichannel Satellite Imagery	Deep learning modelcalled 3DAttentionTCNet iscreated, which is inspired by AlexNet. The pooling layer compresses some important information resulting in the loss of some intensity features, we remove the poolinglayers	Accurate estimationof TC intensity is important to theoretical research studies and practical applications when compared to models like CNN.	Since 3DAttentionTCNet is a deep learning model,the amountof data needed to train the model is huge.

3.	Designing Deep-Based Learning Flood Forecast Model With ConvLSTM HybridAlgorithm	A robust mathematical toolused to determinethe flood state at a particular time for a given area is the Flood Index(IF). A model is developed using ConvLSTM, as an objective model, with alternative methods of LSTM,CNN-LSTM and SVR that can also determine the floodstate.	Early detection of natural disasters suchas floods can greatly assist humans in reducing the extent ofthe damagecaused by such events. The accuracy is high whencompared to other models.	Since model developed using ConvLSTM is a deeplearning model, the amount of data needed to train the model is huge and also time and processor consuming.
4.	A Conformal Regressor With Random Forests for Tropical CycloneIntensity Estimation	A multiple linear regression (MLR) modelwas constructed based on the extraction of the most significant signals and parameters from satellite infrared images.	It is considered an excellent way to extract features fromsatellite images to estimate TC intensity.The Dvorak techniquetried to estimate the TC intensity using visible or infrared images based on thecloudstructure.	The MLR regression technique is exactlynot suitable for all the scenarios of images.

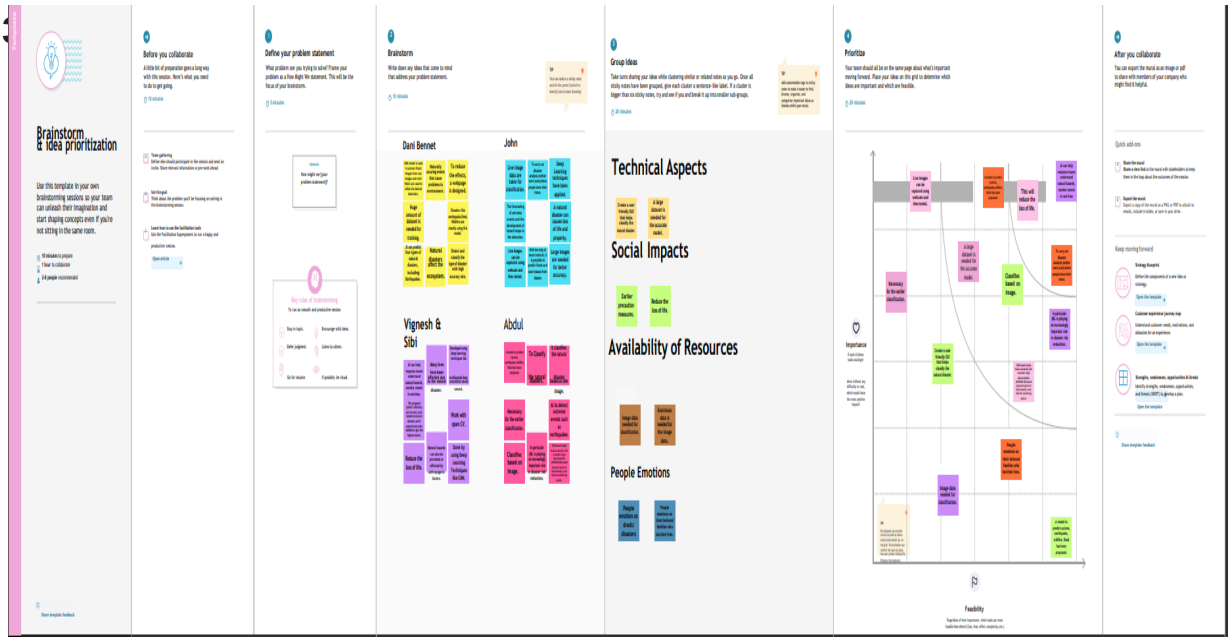
5.	Rainformer: Features Extraction Balanced Networkfor Radar-Based Precipitation Nowcasting	Framework: Rainformer Rainformer consists of an encoder (green box)and decoder (bluebox).They both have four stages. When the stage goes deeper,the feature sizebecomes smaller. Both encoder and decoder include FEBM. FEBM enhances the lowto medium and high- intensity rainfall features at everystage.	It can extract global and local features from radar echomaps separately, and fuses balanced these two features to enhance the model's ability to predict heavy rain or rainstorm.	The Rainformer model is processor complex and also the encoding may not be very efficient.
6.	Quantifying change afternatural disasters to estimate infrastructure damagewith mobile phonedata.	It indicates that howmobility patterns are changing, in the post disaster timeframe, is crucial in order to settle rescuecenters and sendhelp to the most affected areas. We describe the approach takento work with aggregated CDRdata.	We analyzed therelationship between the reach score changes and the damage index of theearthquake in urbanareas, and it showedthat the correlation was negative on the day after the naturaldisaster.	The mobile phone data is sometimes not sufficient forbetter quantification.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to besolved)	To classify the natural disaster and the effect based on the webcam image given as input usingArtificial Intelligence.
2.	Idea / Solution description	The classification is done by deep learning techniques such as Convolutional Neural Network(CNN)and Machine Learning Techniques.
3.	Novelty / Uniqueness	It is based on the satellite and multispectral imageand the classification using Multilayered Deep Convolutional Neural Networks.
4.	Social Impact/ Customer Satisfaction	The people can easily identify the type of naturaldisaster and its effect on the environment whichleads to the earlier identification and reduced damage in the ecosystem.
5.	Business Model(Revenue Model)	We build a system that classifies the natural disaster and its intensity and it is believed thatthewebsite is useful for all people and also the website worksfor a longtime effectively.
6.	Scalabilityof the Solution	The website will be made available for all the people who needs to classify the type of natural disaster. The machine learning and deep learningalgorithms thatare being usedmade it easierfor the classification andintensity analysis.

3.4 Problem Solution fit

Problem – Solution Fit:

The Problem-Solution Fit simply means that you have founda problem with your customerand that the solution you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

Purpose:

a. Solve complex problems in a way that fits the state of yourcustomers.

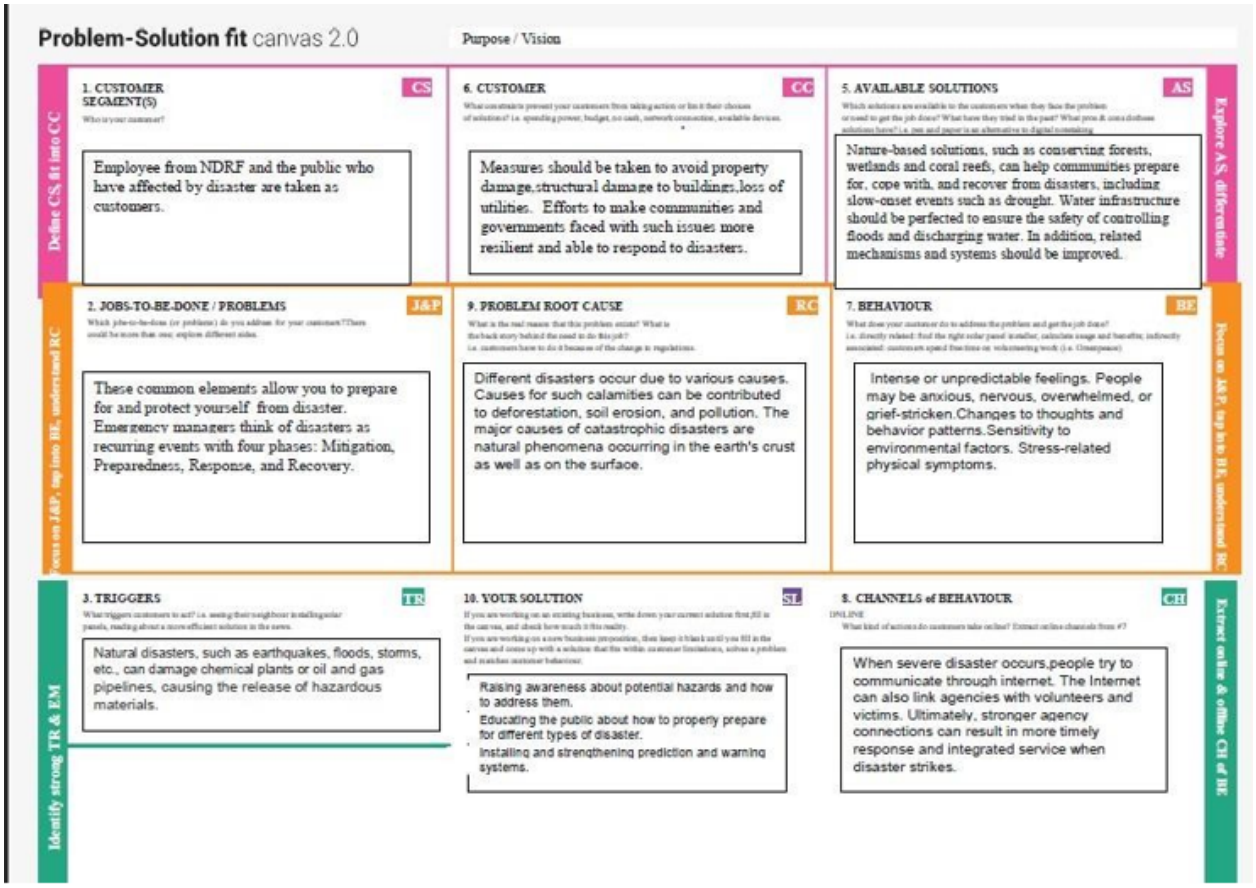
b. Succeedfaster and increase your solution adoptionby tapping into existing mediumsand channels of behavior.

c. Sharpen your communication and marketingstrategy with the right triggersand messaging.

d. Increase touch-points with your company by finding the right problem-behavior fit and building trust by solvingfrequent annoyances, or urgent or costly problems.

e. Understand the existing situation in order to improve it for your target group.

Problem SolutionFit for NaturalDisaster Intensity Analysisand Classification Using Artificial Intelligence:



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	Request Permission	Access permission from web camera.
FR-2	Disaster Prediction	Based on the webcam image, natural disaster is classified.
FR-3	Accuracy	Since the training and testing images are huge, the accuracy is higher.
FR-4	Speed	The generation of results from the input images are faster.
FR-5	Resolution	The resolution of the integrated web camera should be high enough tocapture the video frames.
FR-6	User Interface	Maximizing the interaction in Web Designing Service.

4.2 Non-Functional requirements

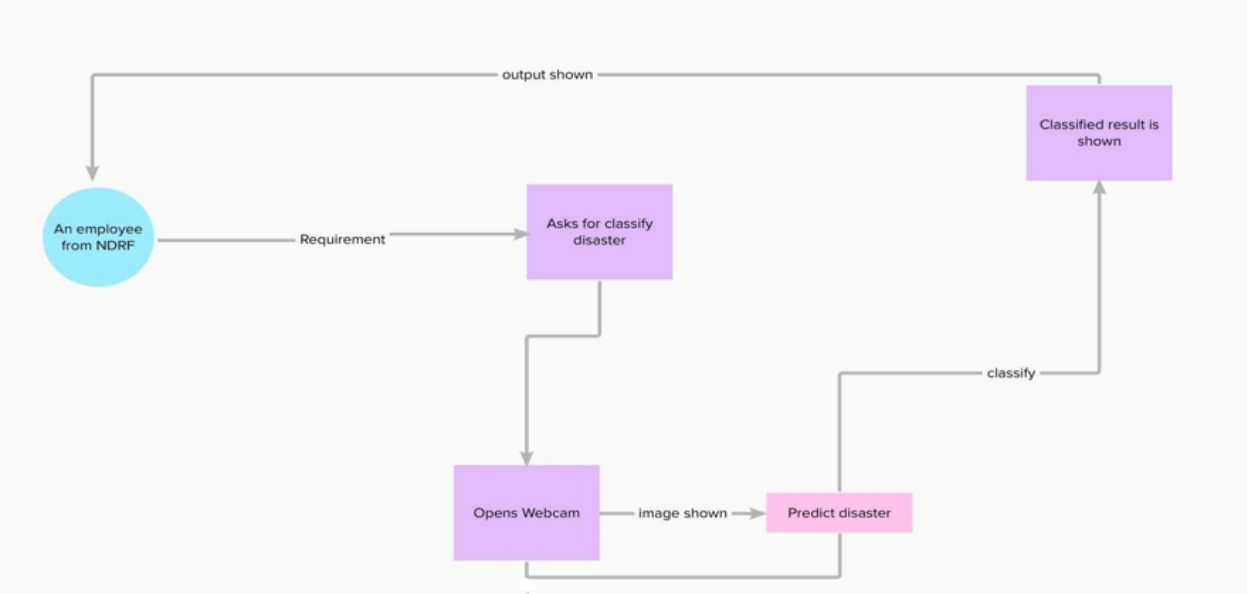
Following are the Non-functional requirements of the proposed solution:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	User friendly and classify the disaster easily.
NFR-2	Security	The model is secure due to the cloud deployment models and also there is no login issue.
NFR-3	Reliability	Accurate prediction of the natural disaster and the website can also be fault tolerant.
NFR-4	Performance	It is shown that the model gives almost 90 percent accuracy after continuous training.
NFR-5	Availability	The website will be made available for 24 hours.
NFR-6	Scalability	The website can run on web browsers like Google chrome, Microsoft edge and also it can be extended to the NDRF and customers.

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 entersand leaves the system, what changes the information, and where data is stored.



5.2 Solution & Technical Architecture

Technical Architecture

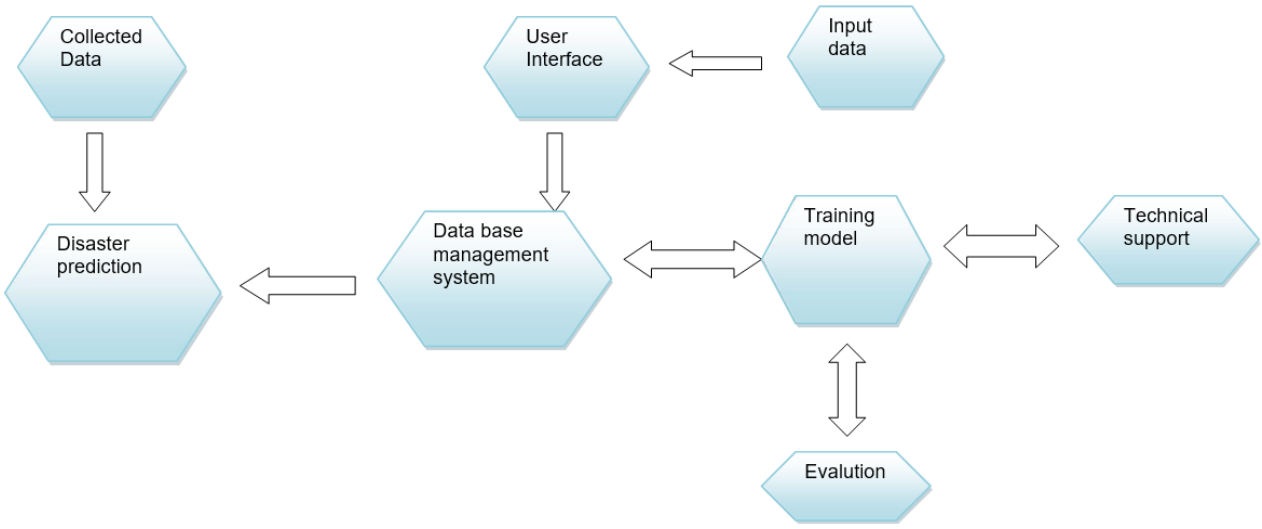


Table-1: Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	User interacts with application for the prediction of Any Natural disaster which will happen in future minutes.	HTML, CSS, JavaScript, Django, Python.
3.	Disaster Prediction	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.
4.	Evaluation system	It monitors that how Algorithm performs on data as well as during training.	Chi-Square, Confusion Matrix, etc.
5.	Input data	To interact with our model and give it problems to solve. Usually this takes the form of an API, a user interface, or a command-line interface.	Application programming interface, etc.
6.	Data collection unit	Data is only useful if it's accessible, so it needs to be stored ideally in a consistent structure and conveniently in one place.	IBM Cloud, SQL Server.
7.	Database management system	An organized collection of data stored in database, so that it can be easily accessed and managed.	MySQL, DynamoDB etc.

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	An open source framework is a template for software development that is designed by a social network of software developers. These frameworks are free for public use and provide the foundation for building a software application.	Keras, Tensor flow.
2.	Authentication	This keeps our models secure and makes sure only those who have permission can use them.	Encryption and Decryption (OTP).
3.	Application interface	User uses mobile application and web application to interact with model	Web Development (HTML,CSS)
4.	Availability (both Online and Offline work)	Its include both online and offline work. As good internet connection is need for online work to explore the software perfectly. Offline work includes the saved data to explore for later time.	Caching, backend server.
5.	Regular Updates	The truly excellent software product needs a continuous process of improvements and updates. Maintain your server and make sure that your content is always up-to-date. Regularly update an app and enrich it with new features.	• Waterfall Approach • Incremental Approach • Spiral Approach
6.	Personalization	Software has features like flexible fonts, backgrounds, settings, colour themes, etc. which make a software interface looks good and functional.	• CSS

5.3 User Stories

Here the list all the user stories for the project“Natural Disaster IntensityAnalysis and Classification Using Artificial Intelligence”.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Registration	USN-1	As a user, registration should be done	Proper email id and password is accepted	High	Sprint-1
Customer	Area to be monitored	USN-2	As user ,I can particularly select the area to be continuously checked and analyzed	The areas should be checked and selected without lapse.	Medium	Sprint-1
Customer	Safety	USN-3	As a user,I should monitor the device is in the secured place which should cover wide area	Safety measures should be done to prevent disaster	High	Sprint-2
Customer	Examination of Natural anamoly	USN-4	As a user,I should analyse the depth of the occurrence of the phenomena	I should monitor the factors which causes disaster	High	Sprint-1
Customer	Battery Backup	USN-5	As a user,I want to check the battery to prevent from power loss	Aware to always keep battery backup .Sometimes it may help in any crucial situations.	Low	Sprint-3
Customer	Algorithm to be used	USN-6	As a user,I should be very conscious in selecting required algorithm	Algorithm provides a correct understanding about the model designed.	Medium	Sprint-4
Customer(Web user)	Internet Connectivity	USN-7	As a user,I should monitor the internet connection periodically	Strong internet connection is required in emergency situations.	High	Sprint-2
Customer(web User)	Social media	USN-8	As a user ,I will be active in social media sites to know more updates about specific diasaster	Active in social media sites to know updates	Medium	Sprint-4
Customer	Prediction and analysis of data	USN-9	As a user,I can ale to predict and visualize data	Using algorithms and some visualization	High	Sprint-3

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

TITLE	DESCRIPTION	DATE
Literature Survey & InformationGathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	3 SEPTEMBER 2022
Prepare EmpathyMap	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list ofproblem statements	10 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and Prioritize the top 3 ideas based onthe feasibility & importance.	10 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	24 SEPTEMBER 2022
Problem SolutionFit	Prepare problem - solutionFit document.	24 SEPTEMBER 2022
Solution Architecture	Prepare solution Architecture document.	4 OCTOBER 2022
Customer Journey	Prepare the customer journeymaps to understand the user interactions & experiences with the application	8 OCTOBER 2022
Data FlowDiagrams	Draw the data flow Diagrams and submit for review.	18 OCTOBER 2022
TechnologyArchitecture	Architecture diagram.	20 OCTOBER 2022
Prepare Milestone& Activity List	Prepare the milestones & Activity list of the project.	27 OCTOBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	COMPLETED

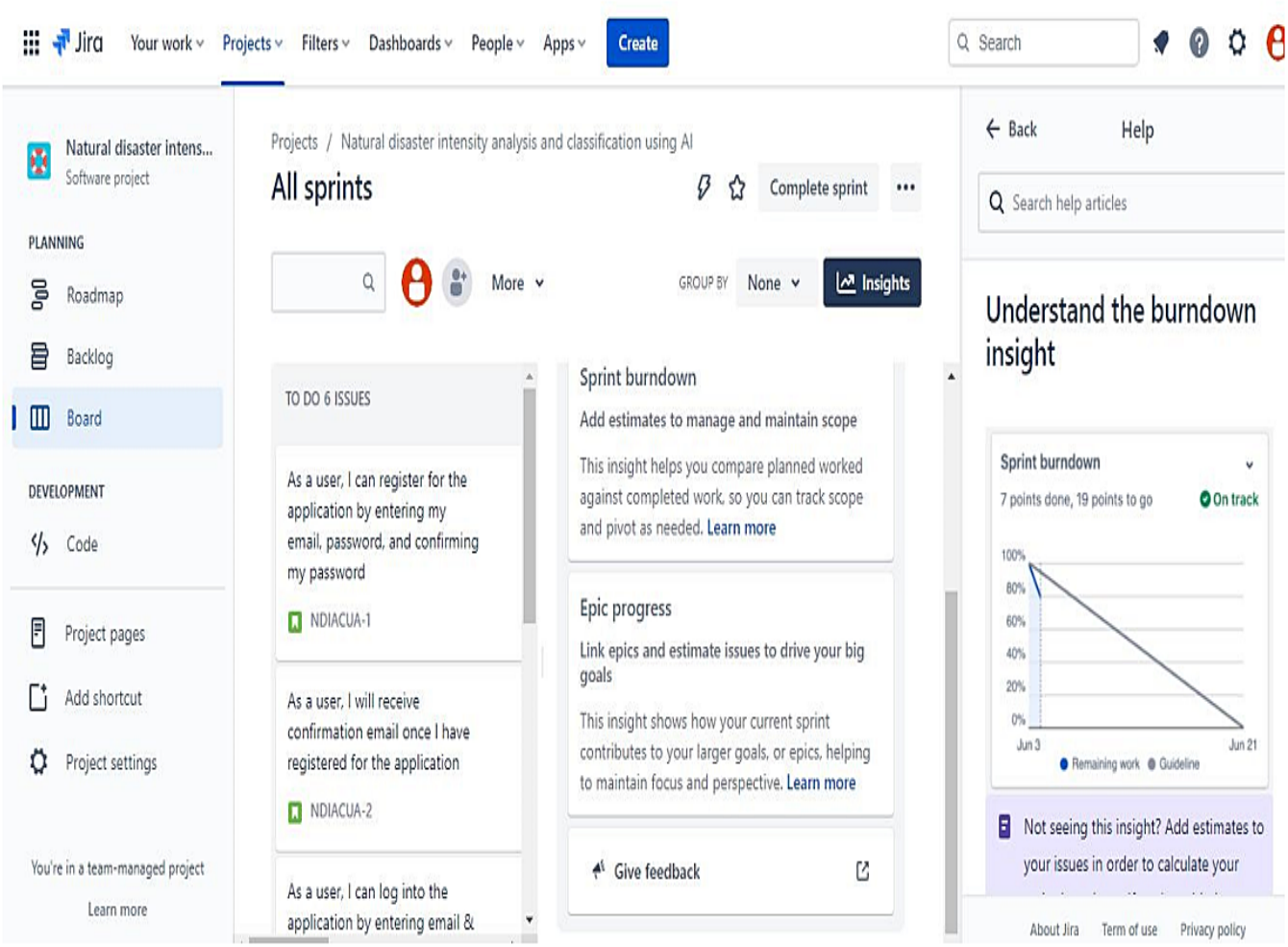
6.2 Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Dani , Vignesh
Sprint-1		USN-2	As a user, I will receive confirmation email oncel have registered for the application	1	High	Hakeem Sibi
Sprint-2		USN-3	As a user, I can register for the applicationthrough Facebook	2	Low	John Sibi
Sprint-2		USN-4	As a user, I can register for the applicationthrough Gmail	2	Medium	Hakeem Dani
Sprint-1	Login	USN-5	As a user, I can log into the application byentering email & password	1	High	Vignesh, Sibi
Sprint-1	Dashboard	USN-6	As a user, I can access the services andinformation provided in the dashboard	2	High	John Dani
Sprint-1	login	USN-7	As a user, I can log into the web application and access the dashboard	2	High	Sibi Hakeem
Sprint-4	Helpdesk	USN-8	As a user, I can get the guidance from thecustomer care	1	High	Vignesh Sibi, John
Sprint-3	Management	USN-9	As an administrator, I can collect new datasetsand keep the model trained	2	High	Dani
Sprint-3		USN-10	As an administrator, I can update other featuresof the application	2	Medium	Hakeem, John
Sprint-3		USN-11	As an administrator, I can maintain theinformation about the user	2	medium	Dani, Sibi
Sprint-4		USN-12	As an administrator, I can maintain third-party services	1	Low	Dani

6.3 Reports from JIRA

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 progressover time.



7. CODING & SOLUTION

7.1 Front End pgrogramming(HTML & CSS)

The layer above the back end is the front end and it includes all software or hardware that is part of a user interface. Human or digital users interact directly with various aspects of the front end of a program, including user-entered data, buttons, programs, websites and other features.

HTML code:

home.html

```
<!DOCTYPE html>
<html lang="en">
 <head>
   <meta charset="UTF-8" />
   <meta http-equiv="X-UA-Compatible" content="IE=edge" />
                                                    <link rel="stylesheet"
href="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/css/bootstrap.min.css"
                                                          integrity="sha384-
9aIt2nRpC12Uk9gS9baDl411NQApFmC26EwAOH8WgZl5MYYxFfc+NcPb1dKGj7Sk"
crossorigin="anonymous">
   <meta name="viewport" content="width=device-width, initial-scale=1.0" />
   <link rel="stylesheet" href="\Static\style.css" />
   <title>Home</title>
 </head>
 <body>
   <nav class="navbar">
     <!-- LOGO -->
         <div class="logo">Natural Disasters Intensity Analysis and Classification using
Artificial Intelligence</div>
     <!-- NAVIGATION MENU -->
     <ul class="nav-links">
       <!-- NAVIGATION MENUS -->
       <div class="menu">
         <li><a href="\Template\Home.html\">Home</a></li>
         <li><a href="\Template\intro.html\">Introduction</a></li>
         <li><a href="\Template\webcam.html\">Open Camera</a></li>
```

```
        <li><a href="\Template\image.html\">Upload</a></li>

      </div>
    </ul>
  </nav>
  <section class="news pt-0">
      <div class="container mt-md-5">
          <h2 class="mx-4 my-0 text-center">Briefing</h2>
            <ul class="row d-lg-flex list-unstyled image-block justify-content-center px-lg-0 mx-lg-0">
              <li class="col-lg-4 col-md-5 image-block full-width p-3">
                <div class="image-block-inner">
                  <a class="mh-100" href="#">
                    <img src="/Images/earthquake.jpg" alt="Earthquake"
                      class="img-responsive w-100"></a>
                  <span class="hp-posts-cat"></span>
                  <h4 class="mt-3"><a href="#">Earthquake</a></h4>
                        <p>a sudden violent shaking of the ground, typically causing great destruction, as a result of movements within the earth's crust or volcanic action</p>
                </div><!-- .image-block-inner -->
              </li>
              <li class="col-lg-4 col-md-5 image-block full-width p-3">
                <div class="image-block-inner">
                  <a class="mh-100" href="#">
                    <img src="\Images\Cyclone.jpg" alt="Cyclone"
                      class="img-responsive w-100"></a>
                  <span class="hp-posts-cat"></span>
                  <h4 class="mt-3"><a href="#">Cyclone</a></h4>
                        <p>a system of winds rotating inwards to an area of low barometric pressure, with an anticlockwise (northern hemisphere) or clockwise (southern hemisphere) circulation; a depression.</p>
                </div><!-- .image-block-inner -->
              </li>
              <li class="col-lg-4 col-md-5 image-block full-width p-3">
                <div class="image-block-inner">
                  <a class="mh-100" href="#">
                    <img src="\Images\flood.jpg" alt="Flood"
```

```
                    class="img-responsive w-100"></a>
                <span class="hp-posts-cat"></span>
                <h4 class="mt-3"><a href="#">Flood</a></h4>
                    <p>Floods can potentially increase the transmission of water- and vector-borne diseases. Find out more about risks associated with flooding on WHO's official website.</p>
            </div><!-- .image-block-inner -->
        </li>
        <li class="col-lg-4 col-md-5 image-block full-width p-3">
            <div class="image-block-inner">
                <a class="mh-100" href="#">
                    <img src="/Images/Wildfire.jpg" alt="Wild Fire"
                        class="img-responsive w-100"></a>
                <span class="hp-posts-cat"></span>
                <h4 class="mt-3"><a href="#">Wild Fire</a></h4>
                    <p>wildfire, also called wildland fire, uncontrolled fire in a forest, grassland, brushland, or land sown to crops. The terms forest fire, brush fire, etc., may be used to describe specific types of wildfires; their usage varies according to the characteristics of the fire and the region in which it occurs.</p>
            </div><!-- .image-block-inner -->
        </li>
    </ul>
  </div>
 </section>
</body>
</html>
```

image.html

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title>Upload</title>
</head>
<body>
<form action="/action_page.php">
  <input type="file" id="myFile" name="filename">
```

```
  <input type="submit">
</form>
</body>
</html>
```

style.css

```
* UTILITIES */
* {
 margin: 0;
 padding: 0;
 box-sizing: border-box;
}
body {
 font-family: cursive;
}
a {
 text-decoration: none;
}
li {
 list-style: none;
}
/* NAVBAR STYLING STARTS */
.navbar {
 display: flex;
 align-items: center;
 justify-content: space-between;
 padding: 20px;
 background-color: teal;
 color: #fff;
}
.nav-links a {
 color: #fff;
}
/* LOGO */
.logo {
 font-size: 20px;
}
```

```
/* NAVBAR MENU */
.menu {
 display: flex;
 gap: 1em;
 font-size: 18px;
}
.menu li:hover {
 background-color: #4c9e9e;
 border-radius: 5px;
 transition: 0.3s ease;
}
.menu li {
 padding: 5px 14px;
}
```

```
.container {
    margin-right: auto;
    margin-left: auto;
    padding-left: 15px;
    padding-right: 15px;
}

.image-block {
    margin-top: 24px;
    display: flex;
    flex-wrap: wrap;
}

.image-block-inner {
    -webkit-box-shadow: 0px 3px 10px 1px rgba(204, 204, 204 0, 1);
```

```
    -moz-box-shadow: 0px 3px 10px 1px rgba(204, 204, 204 0, 1);
    box-shadow: 0px 3px 10px 1px rgba(204, 204, 204, 1);
}

.image-block li>.image-block-inner {
    padding-bottom: 30px;
    background-color: #fff;
    height: 100%;
}

a {
    color: #111;
    text-decoration: none;
}



a:hover {
    text-decoration: none;
}

.image-block li>.image-block-inner>a {
    display: block;
    overflow: hidden;
}

.image-block li>.image-block-inner>a img {
    border: 1px solid #e1e1df;
}

.image-block li>.image-block-inner:hover {
    background-color: #eee;
}

.hp-posts-cat {
    margin-bottom: 13px;
    margin-top: 35px;
```

```
    text-transform: uppercase;
    font-weight: 600;
    font-size: 10 px;
    letter-spacing: 0.1rem;
    display: inline-block;
}

.news {
    font-family: 'Oswald', sans-serif;
}

.news .image-block li>.image-block-inner h4,
.hp-posts-cat,
.news .image-block li>.image-block-inner p,
.read-more {
    padding: 0 28px;
}

.read-more {
    display: block;
    text-decoration: underline;
    margin-top: 30px;
    font-weight: 600;
}

.fill-btn {

    border: 0;
    color: #fff;
    padding: 13px 5px;
    font-size: 16px;
    font-weight: 900;
    font-style: italic;
    text-transform: uppercase;
    width: 252px;
    margin: 0 auto;
    bottom: -25px;
```

```
    left: 50%;
    cursor: pointer;
}

.fill-btn:hover,
.element-btn .element-fill-btn:hover {
    background-color: #201f1f;
    box-shadow: 0px 10px 50px -10px rgb(32, 31, 31);
}

.buttons {
    display: grid;
}

.buttons .fill-btn {
    width: 100%;
    margin-top: 15px;
    margin-bottom: 15px;
}

.buttons .fill-btn:hover,
.fill-btn:hover {
    background-color: #ffe402;
    color: #201f1f;
    box-shadow: 0px 10px 50px -10px rgb(255, 228, 2);
}



/* Media Queries */

@media (min-width: 992px) {
    .col-md-5 {
        width: 41.66667%;
    }
}
```

```
@media (min-width: 768px) {
    .image-block li.image-block1 {
        padding-left: 26px;
        padding-right: 14.5px;
    }
}

@media (min-width: 1200px) {
    .image-block li>.image-block-inner>a {
        max-height: 245px;
    }
}

@media (min-width: 992px) {

    .pl-lg-0,
    .px-lg-0 {
        padding-left: 0;
        padding-right: 0;
    }

    .ml-lg-0,
    .mx-lg-0 {
        margin-left: 0;
        margin-right: 0;
    }
}
```

7.2 Python code:

app.py:

```
from flask import Flask,render_template,request,redirect,url_for
import cv2
import tensorflow as tf
from tensorflow.python.keras.models import load_model
import numpy as np
import os
from werkzeug.utils import secure_filename
app = Flask(__name__ , template_folder="template")
model = load_model(r"/Model Collection/disaster.h5")
print("loaded model from disk")

@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('/webcam', methods=['GET', 'POST'])
def predict():
    print("[INFO] starting video stream...")
    vs = cv2.VideoCapture(0)

    (W, H) = (None, None)


    while True:

        (grabbed, frame) = vs.read()
```

```
        if not grabbed:
            break


        if W is None or H is None:
            (H, W) = frame.shape[:2]


        output = frame.copy()

        frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
        frame = cv2.resize(frame, (64, 64))
        # frame = frame.astype("float32")
        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)
        # result=result.tolist()

                                cv2.putText(output,    "activity:    {}".format(result),    (10,    120),
cv2.FONT_HERSHEY_PLAIN,
                    1, (0, 255, 255), 1)
        # playaudio("Emergency it is a disaster")
        cv2.imshow("Output", output)
        key = cv2.waitKey(1) & 0xFF

        # if the `q` key was pressed, break from the loop
        if key == ord("q"):
            break

    # release the file pointers
    print("[INFO] cleaning up...")
    vs.release()
    cv2.destroyAllWindows()
    return render_template("webcam.html")
```

```
@app.route('/file', methods=['POST', 'GET'])
def video():
    if request.method == 'POST':
        uploaded_file = request.files['file1']
        if uploaded_file.filename != '':
            vid_name = str(uploaded_file.filename)
            print(vid_name + "Uploaded_Succesfully")
            uploaded_file.save(uploaded_file.filename)
            vs = cv2.VideoCapture(vid_name)
            if (vs.isOpened() == False):
                print("Error opening video stream or file")

            (W, H) = (None, None)
            while True:
                (grabbed, frame) = vs.read()
                if not grabbed:
                    break
                if W is None or H is None:
                    (H, W) = frame.shape[:2]
                output = frame.copy()
                frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
                frame = cv2.resize(frame, (64, 64))
                x = np.expand_dims(frame, axis=0)
                result = np.argmax(model.predict(x), axis=-1)
                index = ['Cyclone', 'Earthquake', 'Flood', 'Wildfire']
                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)
                key = cv2.waitKey(1) & 0xFF
                if key == ord("q"):
                    break
            print("[INFO] cleaning up...")
            vs.release()
            cv2.destroyAllWindows()
    return render_template("file.html")
```

```
@app.route('/image', methods=['POST', 'GET'])
def image():
    resulttext = ''
    if request.method == 'POST':
        uploaded_file = request.files['imgfile']
        if uploaded_file.filename != '':
            img_name = str(uploaded_file.filename)
            print(img_name + "Uploaded Succesfully")
            uploaded_file.save(uploaded_file.filename)
            from keras.models import load_model
            from keras.preprocessing import image
            model = load_model("disaster.h5")  # loading the model for testing
            img = image.load_img(img_name, grayscale=False,
                                 target_size=(64, 64))  # loading of the image
            x = image.img_to_array(img)  # image to array
            x = np.expand_dims(x, axis=0)  # changing the shape
            pred = model.predict_classes(x)  # predicting the classes
            index = ['Cyclone', 'Earthquake', 'Flood', 'Wildfire']
            result = index[pred[0]]
            resulttext = result
    return render_template('image.html', result_text=resulttext)


if __name__ == '__main__':
    app.run(host='0.0.0.0', port=8000, debug=True)
```

8. TESTING:

8.1 Test Cases:

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
HomePage_TC_001	UI	Home Page	Verify user is able to see the home page and other tabs , when user entered into the website	Internet and device	1. Enter URL and click go 2. click the tabs in the Navigation Bar	URL FOR THE WEBSITE	Website should be visible	Working as expected	Pass	NA	N	NA	DANI , SIBI, VIGNESH HAKEEM, JOHN
HomePage_TC_002	UI	Home Page	verify user is able to see the results tab		1. Enter URL and click go 2. Click on results tab and check whether the user is able to see the flag card with open button	URL FOR THE WEBSITE	Application should show below UI elements: a header with live stream b. a camera glyphicon c. a button named open	Working as expected	Pass	NA	N	NA	DANI , SIBI, VIGNESH HAKEEM, JOHN
HomePage_TC_003	Functional	Home page	Verify user is able to click the button on the results tab		1. Enter URL and click go 2. Click on results tab and check whether the user is able to click the button named open	URL FOR THE WEBSITE	User should click the button named open	Working as expected	Pass	NA	N	NA	DANI , SIBI, VIGNESH HAKEEM, JOHN
HomePage_TC_004	Functional	access camera	Verify user is able to see that the camera is accessible and open when the button is clicked		1.Enter URL and click go 2.click on results tab 3.click open button	URL FOR THE WEBSITE	Application should able to access the camera and see the livestream	Working as expected	Pass	NA	N	NA	DANI , SIBI, VIGNESH HAKEEM, JOHN
Camera_TC_004	Functional	camera	Verify user is able to capture the image from live stream		1.Enter URL and click go 2.click on results tab 3.click open button 4.camera is opened 5.click q button to capture image	URL FOR THE WEBSITE	Application should able to capture image from livestream	Working as expected	Pass	NA	N	NA	DANI , SIBI, VIGNESH HAKEEM, JOHN
Prediction_TC_005	Functional	output window	Verify user is able to see the predicted results in the window		when the image is captured again click q button to see the results	URL FOR THE WEBSITE	Application should show the predicted results from the image captured	Working as expected	Pass	NA	N	NA	DANI , SIBI, VIGNESH HAKEEM, JOHN

8.2 User Acceptance Testing:

Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Natural DisasterIntensity Analysis and Classification usingArtificial Intelligence projectat thetime of the release to User Acceptance Testing (UAT).

Defect Analysis

This reportshows the number of resolvedor closed bugs at each severitylevel, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	1	0	0	0	1
Duplicate	1	3	3	1	8
External	2	3	0	0	5
Fixed	2	4	4	2	12
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	6	10	7	4	27

Test Case Analysis

This reportshows the number of test cases that have passed,failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	2	0	0	2
Client Application	3	0	0	3
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	1	0	0	1
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9.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.

10.References

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PROJECT SOURCE CODE:

https://github.com/IBM-EPBL/IBM-Project-938-1658331501/tree/main/Project%20design%20-1