NATURAL DISASTERS INTENSITY ANALYSIS AND CLASSIFICATION USING ARTIFICIAL INTELLIGENCE

IBM – DOCUMENTATION

UNDER THE GUIDANCE OF

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

Natural disasters not only disturb the human ecological system but also destroy the properties and critical infrastructures of human societies and even lead to permanent change in the ecosystem. Disaster can be caused by naturally occurring events such as earthquakes, cyclones, floods, and wildfires. Many deep learning techniques have been applied by various researchers to detect and classify natural disasters to overcome losses in ecosystems, but detection of natural disasters still faces issues due to the complex and imbalanced structures of images. To tackle this problem, we developed a multilayered deep convolutional neural network model that classifies the natural disaster and tells the intensity of disaster of natural The model uses an integrated webcam to capture the video frame and the video frame is compared with the Pre-trained model and the type of disaster is identified and showcased on the OpenCV window.

1.2 PURPOSE

Basically the main objective of natural disaster management is to reduce the damage. 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

During the collection and handling of data, it is important to consider: (a) biases in training/testing datasets, (b) new distributed AI technologies within the data domain and (c) ethical issues. In terms of biases in training/testing datasets, it is important to ensure that data are correctly sampled and that there is sufficient representation of each pattern for the problem in question. Consider, for instance, the challenge of building a representative dataset containing examples of extreme events (which are, by nature, rare). Also, imagine the possible costs of failing to provide appropriate data, for instance, wrong predictions or biased outcomes. During the collection and handling of data, it is important to consider: (a) biases in training/testing datasets, (b) new distributed AI technologies within the data domain and (c) ethical issues. In terms of biases in training/testing datasets, it is important to ensure that data are correctly sampled and that there is sufficient representation of each pattern for the problem in question. Consider, for instance, the challenge of building a representative dataset containing examples of extreme events (which are, by nature, rare). Also, imagine the possible costs of failing to provide appropriate data, for instance, wrong predictions or biased outcomes.

2.2 REFERENCES

- Anders, C. J., L. Weber, D. Neumann, W. Samek, K.-R. Müller, S. Lapuschkin, 2022: Finding and removing Clever Hans: Using explanation methods to debug and improve deep models. Information Fusion, 77, 261-295.
- Astafyeva, E., 2019: Ionospheric detection of natural hazards. Reviews of Geophysics, 57, 1265-1288. doi: 10.1029/2019RG000668
- Bach, S., A. Binder, G. Montavon, F. Klauschen, K.-R. Muller, and W. Samek, 2015: On pixel-wise explanations for non-linear classifier decisions by layer-wise relevance propagation. PLoS ONE, 10(7):e0130140.
- Bauer, P., P.D. Dueben, T. Hoefler, T. Quintino, T.C. Schulthess, and N.P. Wedi, 2021: The digital evolution of Earth-system science. Nature Computational Science 1, 104-113.
- Brissaud, Q., and E. Astafyeva, 2021: Near-real-time detection of co-seismic ionospheric disturbances using machine learning, Geophysical Journal International, in review.

2.3 PROBLEM STATEMENT DEFINITION

The purpose of the problem statement is to identify the issue that is a concern and focus it in a way that allows it to be studied in a systematic way. It defines the problem and proposes a way to research a solution, or demonstrates why further information is needed in order for a solution to become possible.

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.

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.

The natural disasters disturbs the ecosystem,both humans and animals.(WHO)

In a disaster, **you face the danger of death or physical injury**. You may also lose your home, possessions, and community. Such stressors place you at risk for emotional and physical health problems. Stress reactions after a disaster look very much like the common reactions seen after any type of trauma.(WHAT)

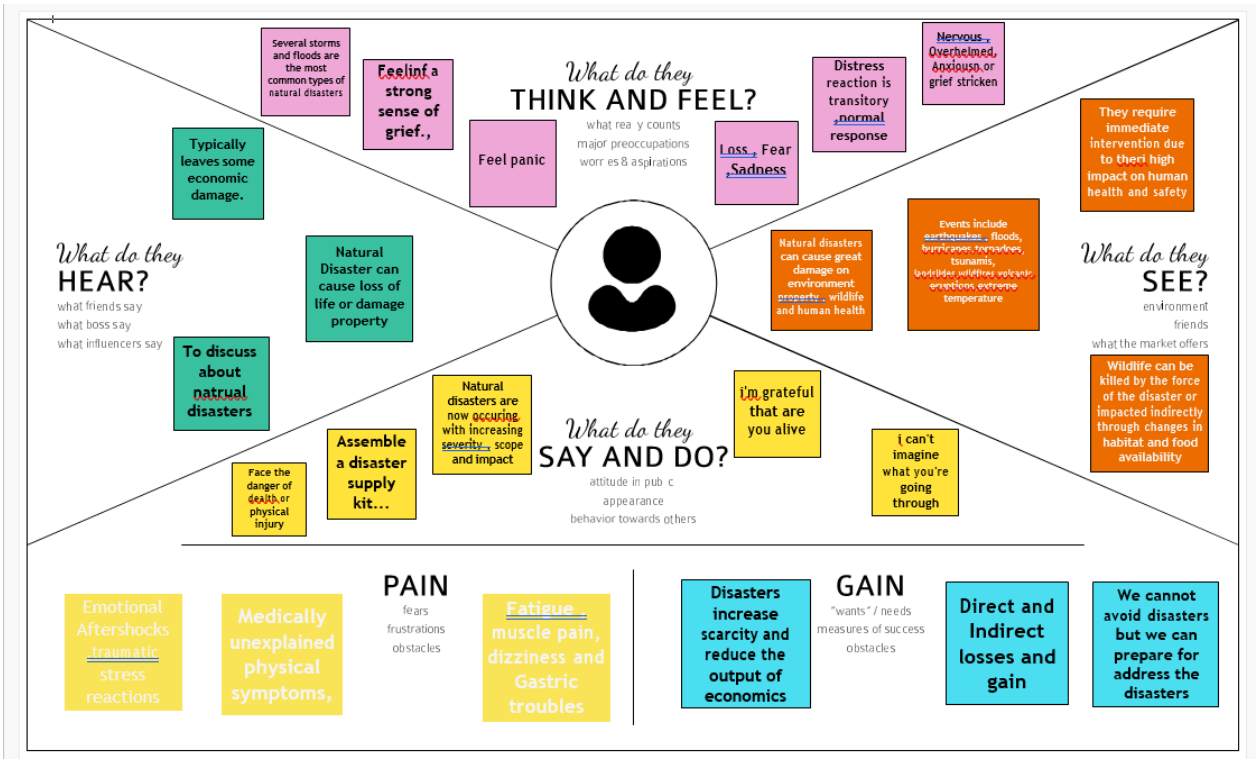
Wildlife can be killed by the force of the disaster or impacted indirectly through changes in habitat and food availability. Endangered species are especially vulnerable when habitat is destroyed. Water quality is impacted when sewage treatment facilities flood or debris enters reservoirs and waterways.(HOW)

Natural disasters generally constitute an emergency since **they require immediate intervention due to their high impact on human health and safety**; they affect the normal functioning of working infrastructure, interrupting normal day activities and representing a risk for residents and workers in affected areas.(WHEN)

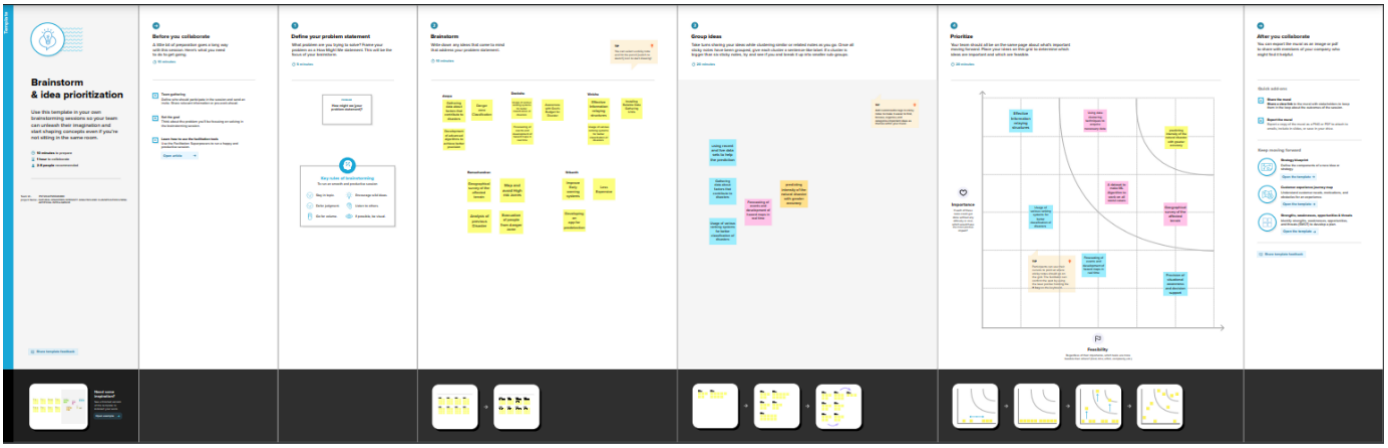
An area is defined as a hazard prone area **if the mortality risk is higher than a certain threshold**. A cyclone is defined as a wind storm with a maximum speed of more than 64 knots per hour. The definition includes typhoons and hurricanes.(WHERE)

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



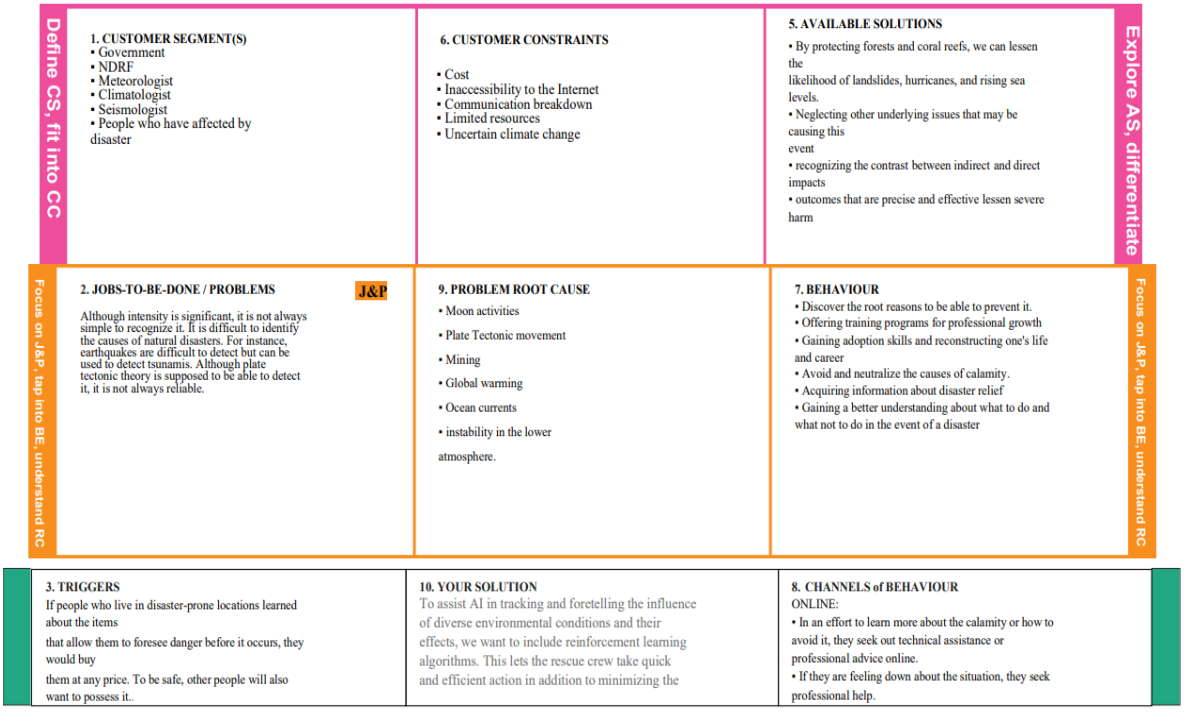
3.2 IDEATION & BRAINSTORMING



3.3 PROPOSED SOLUTION

SI.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	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
2.	Idea / Solution description	The proposed model shows better accuracy as compared to the recently developed techniques. The reason for this is that the proposed technique works in two parts: one for natural disaster occurrence detection and the second one for natural disaster classifications.
3.	Novelty / Uniqueness	We proposed multilayered deep convolutional neural network for detection and intensity classification of natural disasters
4.	Social Impact / Customer Satisfaction	Intensity of the disaster can be measured, which is useful in taking further precautions to avoid damage.
5	Scalability of the Solution	Natural disasters not only disturb the human ecological system and destroy the properties but also causes death of people. By knowing the Intensity. we can make people vacate to safe places.

3.4 PROBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registering via Google Accounts and Registering via Product's own user management system
FR-2	User Authentication	Verification through OTP and Verification through Email Link
FR-3	Designation of Region	Ease of selection of necessary areas to be monitored and Versatile and Flexible operations on designated areas
FR-4	Analysis of Required Phenomenon	Simple and easy analysis on the specific phenomenon to be observed
FR-5	Organizing Unstructured data	Processing of raw and clustered data into clear and refined data which is useful for analysis and prediction tasks
FR-6	Algorithm selection	The freedom to choose from several classes of algorithm to be used in the process and Customization of algorithm to suit the needs of a specific purpose
FR-7	Prediction and analysis of data	Accurate results of the analysis provided by the process and Advanced visualization techniques to help visualize the processed data for effective observation
FR-8	Report generation	Restructuring of obtained results into clear and detailed report for future studies

4.2 NON-FUNCTIONAL REQUIREMENTS

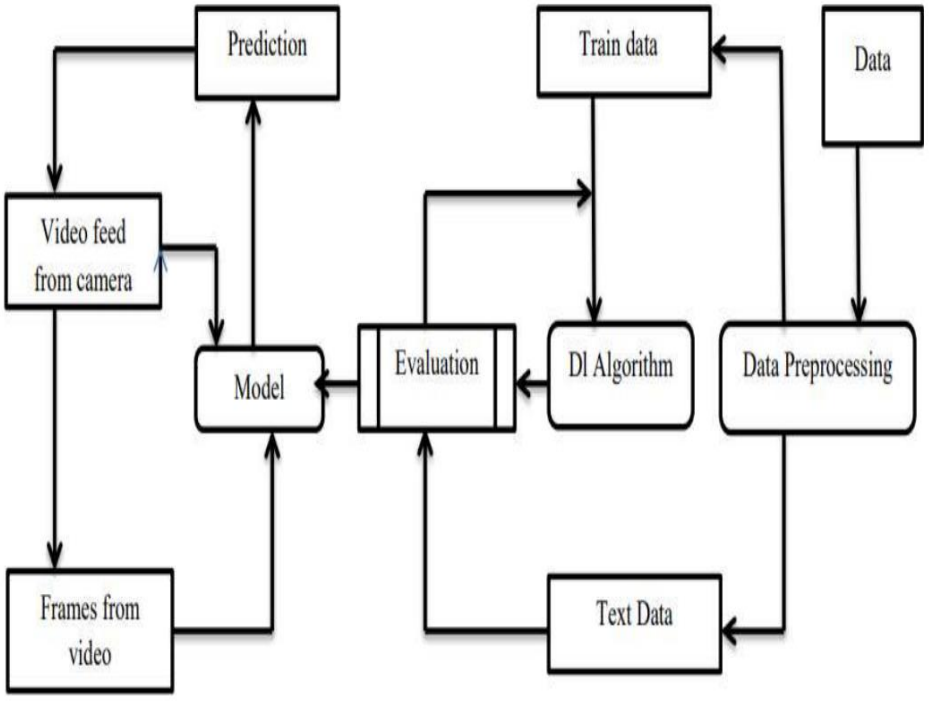
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User friendly and classify the disaster easily
NFR-2	**Security**	It provides a distinctand secure encryption layer to the system interface for additional security standards.
NFR-3	**Reliability**	The product is robust and is capable of execution of processes even in the most difficult and unpredictable environments.
NFR-4	**Performance**	The product boasts a high precision and efficient working capacity which helps in escalating its performance to the highest degree
NFR-5	**Availability**	Despite the complexity and degree of difficulty in its operation, the product is equipped with all-round maintenance and readily available technical services which provides the necessary support any individual requires in their duties
NFR-6	**Scalability**	The product also possess enough room for the improvement of its specifications to upgrade its capabilities according to the needs of the user and their organizatio

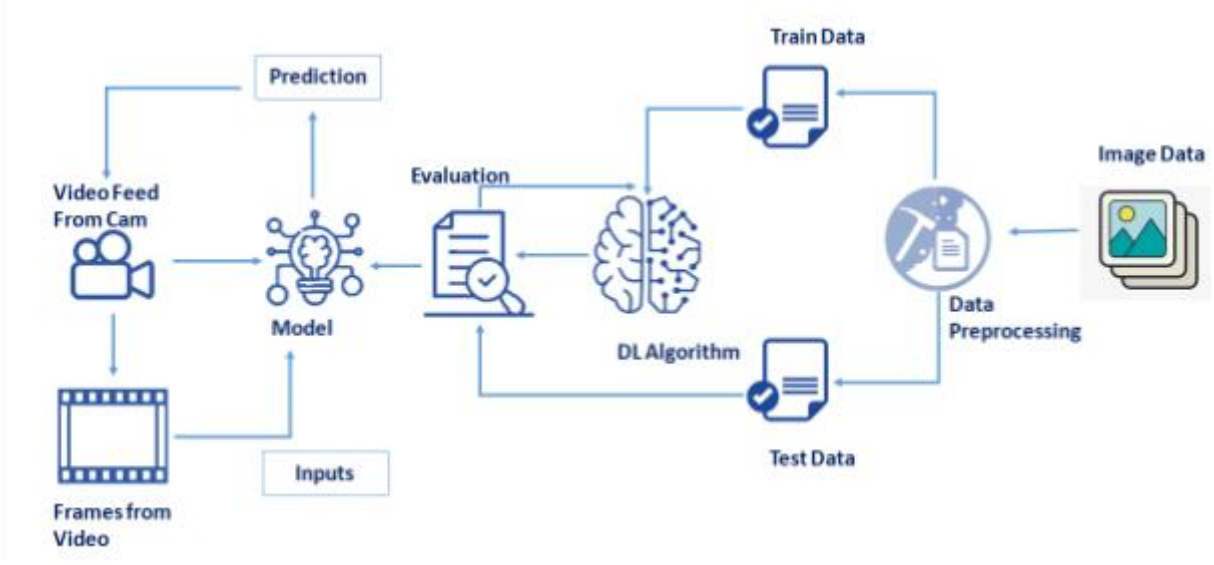
5. PROJECT DESIGN

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



5.2 SOLUTION & TECHNICAL ARCHITECTURE



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Installation	USN-1	As a user, I can install this where the disaster occur	I can do it by myself	High	Sprint-1
customer	Designation of Region	USN-2	I can select the region of interest to be monitored and analyzed	I can choose certain specific places without error	High	Sprint-1
customer	Analysis of Required Phenomenon	USN-3	I am able to monitor certain factors that influence the actions of the phenomenon	I can monitor most of the factors involved in the action	High	Sprint-2
customer	Accumulation of required Data	USN-4	I am able to gather data regarding past events and a detailed report on past analysis	I can allow the storage of data of past events for certain extent	Medium	Sprint-2
customer	Algorithm selection	USN-5	I am able to choose the required algorithm for a specific analysis	I can choose various options for the algorithm to be used	High	Sprint-2
customer	Prediction and analysis of data		I am able to easily predict and visualize the data	I can use easy use prediction and visualization techniques	High	Sprint - 3
Customer (Web user)	Report generation		I am able to generate a clear and detailed report on the analysis	I can generate Report fast and it would be efficient and not complex	Medium	Sprint -4

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint-1	Dashboard	USN-6	As a user, I can access the services and informationprovided in the dashboard	2	High	DEEPA V
Sprint-1	login	USN-7	As a user, I can log into the web application andaccess the dashboard	2	High	SRIKANTH K
Sprint-4	Helpdesk	USN-8	As a user, I can get the guidance from the customercare	1	High	DEEKSHA J
Sprint-3	Management	USN-9	As an administrator, I can collect new datasets andkeep the model trained	2	High	VINISHA N
Sprint-3		USN-10	As an administrator, I can update other features of the application	2	Medium	DEEPA V
Sprint-3		USN-11	As an administrator, I can maintain the information about the user	2	Medium	SRIKANTH K
Sprint-4		USN-12	As an administrator, I can maintain third-party services	1	Low	DEEKSHA J

6.2 SPRINT DELIEVERY 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	8	6 Days	26 Oct 2022	31 Oct 2022	8	29 Oct 2022
Sprint-2	4	6 Days	1 Oct 2022	05 Nov 2022	4	05 Nov 2022
Sprint-3	6	6 Days	6 Nov 2022	10 Nov 2022	6	12 Nov 2022
Sprint-4	2	6 Days	10 Nov 2022	13 Nov 2022	2	19 Nov 2022

7. TESTING

7.1 TEST CASES

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	9	0	0	9
Client Application	40	0	0	40
Security	3	0	0	3
Out-source Shipping	3	0	0	3
Exception Reporting	8	0	0	8
Final Report Output	4	0	0	4
Version Control	2	0	0	2

7.2 USER ACCEPTANCE TESTING

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	4	5	2	3	14
Duplicate	1	0	3	1	5
External	2	3	0	1	6
Fixed	9	2	4	15	30
Not Reproduced	0	0	1	0	1
Skipped	1	0	1	1	3
Won't Fix	0	5	2	1	8
Totals	17	14	13	22	64

8. RESULT

8.1 PERFORMANCE METRICS

Project team shall fill the following information in model performance testing.

S.No.	Parameter	Values(Percentage)
1.	Model Summary	-96%
2.	Accuracy	Training Accuracy - 96.5% Validation Accuracy -92.3%
3.	Confidence Score (Only Yolo Projects)	Class Detected - Nil Confidence Score - Nil

9. ADVANTAGES & 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.

- Disaster management plays an integral role in keeping communities safe. It involves coordinating the resources, such as pollution control systems, and responsibilities, such as following best practice policies, needed to prevent, prepare for, respond to, and recover from emergencies.

DISADVANTAGES:

- A forest fire is a natural disaster that cannot be forecasted.
- Sometimes the prediction may fail and result in huge loss.

10. CONCLUSION

Natural disasters inflict severe damage on almost the entire spectrum of social and natural habitats, ranging from housing and shelter, water, food, health, sanitation, and waste management to information and communication networks, supply of power and energy, and transportation intrastecture. The major challenges faced in all disasters include pre-disaster early warning infrastructure; the supply of food and clean drinking water; health and sanitation; information and communication; power and energy for lighting and cooking; waste collection and disposal, including rapid disposal of dead bodies of humans and animals; disaster-proof housing and shelter; emergency and post-disaster shelters; rescue and relief operations; and transport infrastructure. Though it is not possible to prevent most of the disasters, still their effects can be alleviated or mitigated in magnitude by anticipated preparedness. Advanced disaster management technology could provide a critical support system for disaster management authorities at times of disaster-related crises. Such a technology also provides important inputs for any disaster management plan of action in modern times. Communities and individuals have to be educated on pre-disaster planning and preparedness. Awareness must be created amongst masses, for which first-aid training at grass roots level is essential. There should be a National Disaster Plan that defines the tasks of the communities and local health personnel.

11. FUTURE SCOPE

Natural disasters inflict severe damage on almost the entire spectrum of social and natural habitats, ranging from housing and shelter, water, food, health, sanitation, and waste management to information and communication networks, supply of power and energy, and transportation intrastecture. The major challenges faced in all disasters include pre-disaster early warning infrastructure; the supply of food and clean drinking water; health and sanitation; information and communication; power and energy for lighting and cooking; waste collection and disposal, including rapid disposal of dead bodies of humans and animals; disaster-proof housing and shelter; emergency and post-disaster shelters; rescue and relief operations; and transport infrastructure. Though it is not possible to prevent most of the disasters, still their effects can be alleviated or mitigated in magnitude by anticipated preparedness. Advanced disaster management technology could provide a critical support system for disaster management authorities at times of disaster-related crises. Such a technology also provides important inputs for any disaster management plan of action in modern times. Communities and individuals have to be educated on pre-disaster planning and preparedness. Awareness must be created amongst masses, for which first-aid training at grass roots level is essential. There should be a National Disaster Plan that defines the tasks of the communities and local health personnel.

12. APPENDIX

12.1 SOURCE CODE

home.html:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>Home Page</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
  <link href="https://fonts.googleapis.com/css?family=Montserrat" rel="stylesheet"
type="text/css">
  <link href="https://fonts.googleapis.com/css?family=Lato" rel="stylesheet" type="text/css">
  <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script>
  <script src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>

  <style>
  body {
    font: 400 15px Lato, sans-serif;
    line-height: 1.8;
    color: #818181;
  }
  h2 {
    font-size: 24px;
    text-transform: uppercase;
    color: #303030;
    font-weight: 600;
    margin-bottom: 30px;
  }
  h4 {
    font-size: 19px;
```

```
  line-height: 1.375em;
  color: #303030;
  font-weight: 400;
  margin-bottom: 30px;
}
.jumbotron {
  background-color: #f4511e;
  color: #fff;

  font-family: Montserrat, sans-serif;
}
.container-fluid {
  padding: 60px 50px;
}
.bg-grey {
  background-color: #f6f6f6;
}
.logo-small {
  color: #f4511e;
  font-size: 50px;
}
.logo {
  color: #f4511e;
  font-size: 200px;
}
.thumbnail {
  padding: 0 0 15px 0;
  border: none;
  border-radius: 0;
}
.thumbnail img {
  width: 100%;
  height: 100%;
```

```
  margin-bottom: 10px;
}
.carousel-control.right, .carousel-control.left {
  background-image: none;
  color: #f4511e;
}
.carousel-indicators li {
  border-color: #f4511e;
}
.carousel-indicators li.active {
  background-color: #f4511e;
}
.item h4 {
  font-size: 19px;
  line-height: 1.375em;
  font-weight: 400;
  font-style: italic;
  margin: 70px 0;
}
.item span {
  font-style: normal;
}
.panel {
  border: 1px solid #f4511e;
  border-radius:0 !important;
  transition: box-shadow 0.5s;
}
.panel:hover {
  box-shadow: 5px 0px 40px rgba(0,0,0, .2);
}
.panel-footer .btn:hover {
  border: 1px solid #f4511e;
  background-color: #fff !important;
```

```
  color: #f4511e;
}
.panel-heading {
  color: #fff !important;
  background-color: #f4511e !important;
  padding: 25px;
  border-bottom: 1px solid transparent;
  border-top-left-radius: 0px;
  border-top-right-radius: 0px;
  border-bottom-left-radius: 0px;
  border-bottom-right-radius: 0px;
}
.panel-footer {
  background-color: white !important;
}
.panel-footer h3 {
  font-size: 32px;
}
.panel-footer h4 {
  color: #aaa;
  font-size: 14px;
}
.panel-footer .btn {
  margin: 15px 0;
  background-color: #f4511e;
  color: #fff;
}
.navbar {
  margin-bottom: 0;
  background-color: #0059ff;
  z-index: 9999;
  border: 0;
  font-size: 12px !important;
```

```
  line-height: 1.42857143 !important;
  letter-spacing: 4px;
  border-radius: 0;
  font-family: Montserrat, sans-serif;
}
.navbar li a, .navbar .navbar-brand {
  color: #fff !important;
}
.navbar-nav li a:hover, .navbar-nav li.active a {
  color: #f4511e !important;
  background-color: #fff !important;
}
.navbar-default .navbar-toggle {
  border-color: transparent;
  color: #fff !important;
}
footer .glyphicon {
  font-size: 20px;
  margin-bottom: 20px;
  color: #f4511e;
}
.slideanim {visibility:hidden;}
.slide {
  animation-name: slide;
  -webkit-animation-name: slide;
  animation-duration: 1s;
  -webkit-animation-duration: 1s;
  visibility: visible;
}
@keyframes slide {
  0% {
    opacity: 0;
    transform: translateY(70%);
```

```
  }
  100% {
    opacity: 1;
    transform: translateY(0%);
  }
}
@-webkit-keyframes slide {
  0% {
    opacity: 0;
    -webkit-transform: translateY(70%);
  }
  100% {
    opacity: 1;
    -webkit-transform: translateY(0%);
  }
}
@media screen and (max-width: 768px) {
  .col-sm-4 {
    text-align: center;
    margin: 25px 0;
  }
  .btn-lg {
    width: 100%;
    margin-bottom: 35px;
  }
}
@media screen and (max-width: 480px) {
  .logo {
    font-size: 150px;
  }
}

.container {
```

```
    padding: 16px;
    max-width: max-content;
}

.container {
    max-width: 1376px;
    margin: auto;
    padding: 2rem 1.5rem;
}

.cards {
    display: flex;
    flex-wrap: wrap;
    align-items: center;
    justify-content: center;
  }

  .card {
    cursor: pointer;
    background-color: transparent;
    height: 300px;
    perspective: 1000px;
    margin: 1rem;
    align-items: center;
    justify-content: center;
  }

  .card h3 {
    border-bottom: 1px #fff solid;
    padding-bottom: 10px;
    margin-bottom: 10px;
    text-align: center;
    font-size: 1.6rem;
```

```
  word-spacing: 3px;
}

.card p{
  opacity: 0.75;
  font-size: 0.8rem;
  line-height: 1.4;
}

.card img {
  width: 360px;
  height: 300px;
  object-fit: cover;
  border-radius: 3px;
}

.card-inner {
  position: relative;
  width: 360px;
  height: 100%;
  transition: transform 0.9s;
  transform-style: preserve-3d;
}

.card:hover .card-inner {
  transform: rotateY(180deg);
}

.card-front,
.card-back {
  position: absolute;
  width: 360px;
  height: 100%;
```

```
        -webkit-backface-visibility: hidden;
        backface-visibility: hidden;
      }

      .card-back {
        background-color: #222;
        color: #fff;
        padding: 1.5rem;
        transform: rotateY(180deg);
      }
      .text-block {
        position: absolute;
        bottom: 20px;
        right: 20px;
        background-color: black;
        color: white;

        padding-left: 20px;
        padding-right: 20px;
      }
.features-section img {
    display: none;
  }

  .testimonials-section {
    background: var(--primary-colour);
    color: white;
  }

  .testimonials-section li {
    background: #0059ff;
    text-align: center;
    width: 80%;
```

```
  border-radius: 1em;
 }

 .testimonials-section li img {
  width: 6em;
  height: 6em;
  border: 3px solid #ffffff;
  border-radius: 50%;
  margin-top: -2.5em;
 }

 ul {
  list-style-type: none;
  margin: 0;
  padding: 0;
 }


ul.features-list {
  margin: 0;
  padding-left: .1em;
 }

 ul.features-list li {
  font-size: 1.1em;
  margin-bottom: 1em;
  margin-left: 2em;
  position: relative;
 }

 ul.features-list li:before {
  content: '';
  left: -2em;
```

```
    position: absolute;
    width: 20px;
    height: 20px;
    background-image: url("#");
    background-size: contain;
    margin-right: .5em;
  }

  .features-section img {
    display: none;
  }
  </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 active" aria-current="true" href="home.html" style="font-size:
24px;">Home</a>
</li>
<li class="nav-item">
<a class="nav-link" href="intro.html" style="font-size: 24px;">Introduction</a>
</li>
<li class="nav-item">
<a class="nav-link" href="upload.html" style="font-size: 24px;">Upload</a>
</li>
</ul>
<h3 style="float: right;">AI based Natural Disaster Analysis</h3>
</div>
<div class="container-fluid">
    <div class="container">
```

```
    <div class="cards">

      <div class="card">
        <div class="card-inner">
          <div class="card-front">
            <img src="https://images.unsplash.com/photo-1454789476662-
53eb23ba5907?ixid=MXwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHw%3D&ixlib
=rb-1.2.1&auto=format&fit=crop&w=689&q=80"
              alt="">
            <div class="text-block">
              <h1>Cyclone</h1>
              <h3>violent winds, torrential rain, high waves and, very destructive
storm</h3>
            </div>

          </div>
          <div class="card-back">
            <h3>Cyclone</h3>
            <h3>The effects of tropical cyclones include heavy rain, strong wind, large storm
surges near
              landfall, and tornadoes. The destruction from a tropical cyclone, such as a
hurricane or
              tropical storm, depends mainly on its intensity, its size, and its location.</h3>
          </div>
        </div>
      </div>
  <div class="container">

        <div class="cards">

          <div class="card">
            <div class="card-inner">
              <div class="card-front">
```

```
                    <img src="https://images.unsplash.com/photo-1603869311144-
66b03d340b32?ixid=MXwxMjA3fDB8MHxzZWFyY2h8M3x8ZWFydGhxdWFrZXxlbnwwfH
wwfA%3D%3D&ixlib=rb-1.2.1&auto=format&fit=crop&w=500&q=60"
                      alt="">
                    <div class="text-block">
                      <h1>Earth Quake</h1>
                      <h3>Sudden release of stored energy in the Earth's crust that creates
seismic waves.
                      </h3>
                    </div>

                  </div>
                  <div class="card-back">
                    <h3>Earth Quake</h3>
                    <h3>Earthquakes are usually caused when rock underground suddenly
breaks along a fault.
                      This sudden release of energy causes the seismic waves that make the
ground shake.
                      ... During the earthquake and afterward, the plates or blocks of rock start
moving,
                      and they continue to move until they get stuck again.</h3>
                  </div>
                </div>
              </div>
 <div class="container">
<div class="cards">
  <div class="card">
                    <div class="card-inner">
                      <div class="card-front">
                        <img src="https://images.unsplash.com/photo-1547683905-
f686c993aae5?ixid=MXwxMjA3fDB8MHxzZWFyY2h8MXx8Zmxvb2R8ZW58MHx8MHw%
3D&ixlib=rb-1.2.1&auto=format&fit=crop&w=500&q=60"
                          alt="">
                        <div class="text-block">
                          <h1>Flood</h1>
```

```
                        <h3>A flood is an overflow of water on normally dry ground</h3>
                    </div>


                </div>
                <div class="card-back">
                    <h3>Flood</h3>
                    <h3>During heavy rain, the storm drains can become overwhelmed or
plugged by
                        debris and flood the roads and buildings nearby. Low spots, such as
                        underpasses, underground parking garages, basements, and low water
crossings
                        can become death traps. Areas near rivers are at risk from
floods.</h3>
                </div>
            </div>
        </div>
    <div class="container">

                <div class="cards">


                    <div class="card">
                        <div class="card-inner">
                            <div class="card-front">
                                <img src="https://images.unsplash.com/photo-1473260079709-
83c808703435?ixid=MXwxMjA3fDB8MHxzZWFyY2h8NHx8d2lsZGZpcmV8ZW58MHx8M
Hw%3D&ixlib=rb-1.2.1&auto=format&fit=crop&w=500&q=60"
                                    alt="">
                                <div class="text-block">
                                    <h1>WildFire</h1>
                                    <h3>Uncontrolled fire in a forest, grassland, brushland</h3>
                                </div>


                            </div>
                            <div class="card-back">
```

```
                        <h3>Wildfire</h3>
                        <h3>Wildfires can be caused by an accumulation of dead matter
(leaves,
                            twigs, and trees) that can create enough heat in some instances
to
                            spontaneously combust and ignite the surrounding area.
Lightning
                            strikes the earth over 100,000 times a day. 10 to 20% of these
                            lightning strikes can cause fire.</h3>
                    </div>
                </div>
            </div>
</div>
```

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="home.html" style="font-size:
24px;">Home</a>
```

```
</li>
<li class="nav-item">
<a class="nav-link active" href="intro.html" style="font-size: 24px;">Introduction</a></li>
<li class="nav-item">
<a class="nav-link" href="upload.html" 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 objectiveofthe 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>
</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="home.html" style="font-size:
24px;">Home</a>
</li>
<li class="nav-item">
<a class="nav-link" href="intro.html" style="font-size: 24px;">Introduction</a>
</li>
<li class="nav-item">
<a class="nav-link active" href="upload.html" style="font-size: 24px;">Upload</a>
</li>
</ul>
<h3 style="float: right;">AI based Natural Disaster Analysis</h3>
</div>
</div>
<form action = "uploader.html" method = "POST" enctype = "multipart/form-data">
<input type = "file" name = "filename" />
<input type = "submit" value="Submit"/>
</form>
<script src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.11.6/dist/umd/popper.min.js"
integrity="sha384-
oBqDVmMz9ATKxIep9tiCxS/Z9fNfEXiDAYTujMAeBAsjFuCZSmKbSSUnQlmh/jp3"
crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/js/bootstrap.min.js"
```

integrity="sha384-IDwe1+LCz02ROU9k972gdyvl+AESN10+x7tBKgc9I5HFtuNz0wWnPclzo6p9vxnk"crossorigin="anonymous"></script>

</body>

</html>

```
# -*- coding: utf-8 -*-
"""
Created on Sat Oct 24 00:48:19 2020
@author: Tulasi
"""


# USAGE

# import the necessary packages
from flask import Flask, render_template, request, redirect, url_for
# Flask-It is our framework which we are going to use to run/serve our application.
# request-for accessing file which was uploaded by the user on our application.
#import operator
import cv2  # opencv library
from tensorflow.keras.models import load_model  # to load our trained model
import numpy as np
#import os
from werkzeug.utils import secure_filename
#from playsound import playsound
#from gtts import gTTS

app = Flask(__name__, template_folder="templates")  # initializing a flask app
# Loading the model
```

AI based Natural disaster analysis.ipynb

AI based Natural disaster analysis

Importing Neccessary Libraries

```
[ ]  import numpy as np#used for numerical analysis
     import tensorflow #open source used for both ML and DL for computation
     from tensorflow.keras.models import Sequential #it is a plain stack of layers
     from tensorflow.keras import layers #A layer consists of a tensor-in tensor-out computation function
     #Dense layer is the regular deeply connected neural network layer
     from tensorflow.keras.layers import Dense,Flatten
     #Faltten-used fot flattening the input or change the dimension
     from tensorflow.keras.layers import Conv2D,MaxPooling2D #Convolutional layer
     #MaxPooling2D-for downsampling the image
     from keras.preprocessing.image import ImageDataGenerator
```

```
Using TensorFlow backend.
```

Loading our data and performing data agumentation

```
[ ] #performing data agumentation to train data
    x_train = train_datagen.flow_from_directory(r'E:\SB1\dataset\dataset\dataset\test_set',target_size=(64, 64),batch_size=5,
                                                color_mode='rgb',class_mode='categorical')
    #performing data agumentation to test data
    x_test = test_datagen.flow_from_directory(r'E:\SB1\dataset\dataset\dataset\test_set',target_size=(64, 64),batch_size=5,
                                              color_mode='rgb',class_mode='categorical')
```

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

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

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

+ Code + Text

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

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

Creating the model

```
# Initializing the CNN
classifier = Sequential()

# First convolution layer and poolingo
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
classifier.add(MaxPooling2D(pool_size=(2, 2)))
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
# Second convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), activation='relu'))
# input_shape is going to be the pooled feature maps from the previous convolution layer
classifier.add(MaxPooling2D(pool_size=(2, 2)))
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))

# Flattening the layers
classifier.add(Flatten())

# Adding a fully connected layer
classifier.add(Dense(units=128, activation='relu'))
classifier.add(Dense(units=4, activation='softmax')) # softmax for more than 2
```

Fitting the model

```
[ ] classifier.fit_generator(
            generator=x_train,steps_per_epoch = len(x_train),
            epochs=40, validation_data=x_test,validation_steps = len(x_test))# No of images in test set
```

```
40/40 [==============================] - 9s 239ms/step - loss: 0.7445 - accuracy: 0.7266 - val_loss: 0.6234 - val_accuracy: 0.7172
Epoch 13/40
40/40 [==============================] - 9s 239ms/step - loss: 0.5752 - accuracy: 0.7508 - val_loss: 0.5389 - val_accuracy: 0.7980
Epoch 14/40
40/40 [==============================] - 10s 242ms/step - loss: 0.6582 - accuracy: 0.7428 - val_loss: 0.4447 - val_accuracy: 0.8283
Epoch 15/40
40/40 [==============================] - 9s 240ms/step - loss: 0.5318 - accuracy: 0.7766 - val_loss: 0.4859 - val_accuracy: 0.8131
Epoch 16/40
40/40 [==============================] - 9s 240ms/step - loss: 0.4472 - accuracy: 0.8269 - val_loss: 0.6708 - val_accuracy: 0.7273
Epoch 17/40
40/40 [==============================] - 10s 246ms/step - loss: 0.5900 - accuracy: 0.7400 - val_loss: 0.6847 - val_accuracy: 0.7525
Epoch 18/40
40/40 [==============================] - 10s 249ms/step - loss: 0.5226 - accuracy: 0.8148 - val_loss: 0.8422 - val_accuracy: 0.7222
Epoch 19/40
40/40 [==============================] - 11s 277ms/step - loss: 0.5587 - accuracy: 0.8253 - val_loss: 0.4669 - val_accuracy: 0.8081
Epoch 20/40
```

Saving our model

```
[ ]  # Save the model
     classifier.save('disaster_f.h5')
```

```
[ ]  model_json = classifier.to_json()
     with open("model-bw.json", "w") as json_file:
         json_file.write(model_json)
```

```
[ ]
```

Predicting our results

```
from tensorflow.keras.models import load_model
from keras.preprocessing import image
#model = load_model("disaster_f.h5") #loading the model for testing
```

c_check_earthquake.py:

```
def check_earthquakes_location(lat_out=float,lon_out=float):

    try:

        TARGET_REQ_URL = "https://www.emsc-csem.org/service/rss/rss.php?typ=emsc"

        REQ_TARGET = requests.get(TARGET_REQ_URL).text
        SOUP_TARGET = BeautifulSoup(REQ_TARGET,"html.parser")

        FIND_ALL_IT = SOUP_TARGET.find_all("item")

        checking_value = 0

        print("\n")
        time.sleep(1.2)
        print("CONNECTED PORTAL I")


        for x_loop in FIND_ALL_IT:

            TITLE_OUT = x_loop.find("title")
            LAT_OUT = x_loop.find("geo:lat")
            LON_OUT = x_loop.find("geo:long")
```

C_earthquake_g.py:

```
def get_earthquake(count_search=int):

    SOURCE_URL ='https://ds.iris.edu/seismon/eventlist/index.phtml'

    try:

        MAIN_URL_REQ = requests.get(SOURCE_URL).text
        MAIN_SOUP_URL = BeautifulSoup(MAIN_URL_REQ,"html.parser")
        PARAMS_ALL_GET = MAIN_SOUP_URL.find_all("table",class_="tablesorter")

        i_count_stop = 0

        for X_DETAIL in PARAMS_ALL_GET:

            DETAIL_TR_ALL = X_DETAIL.find_all("tr")

            for x_d in DETAIL_TR_ALL:

                LIST_DETAIL_ALL = x_d.text.replace("\n",",").split(",")
                i_count_stop += 1

                if 1 < i_count_stop < count_search:
```

c_alternative_earthquake.py:

```
def get_alternative_earthquake():

    TARGET_REQ_URL = "https://www.emsc-csem.org/service/rss/rss.php?typ=emsc"

    REQ_TARGET = requests.get(TARGET_REQ_URL).text
    SOUP_TARGET = BeautifulSoup(REQ_TARGET,"html.parser")

    FIND_ALL_IT = SOUP_TARGET.find_all("item")

    try:

        for x_loop in FIND_ALL_IT:

            TITLE_OUT = x_loop.find("title")
            LAT_OUT = x_loop.find("geo:lat")
            LON_OUT = x_loop.find("geo:long")
            DEP_OUT = x_loop.find("emsc:depth")
            MAG_OUT = x_loop.find("emsc:magnitude")
            TIME_OUT = x_loop.find("emsc:time")
            ST_OUT = x_loop.find("status")

            time.sleep(0.8)
            print("\n")
```

C_flood.py:

```
def get_flood(count_search=int):

    try:

        GDACS_TARGET = requests.get("https://www.gdacs.org/default.aspx").text
        SOUP_GDACS = BeautifulSoup(GDACS_TARGET,"html.parser")
        ALL_F_DISASTER = SOUP_GDACS.find_all("div",id="mainListFl")

        CONTROL_VALUE_LIST = []

        i_count_stop = 0


        for x_att in ALL_F_DISASTER:

            ALERT_DETAIL_LINK = x_att.find_all("a")

            for x_detail_link in ALERT_DETAIL_LINK:

                LINK_AFTER_SITE = str(x_detail_link.get("href"))

                SUB_TARGET = requests.get(LINK_AFTER_SITE).text
                SOUP_GDACS_FUNCTION = BeautifulSoup(SUB_TARGET,"html.parser")
```

c_help.py:

```
def how_to_use():

    try:

        MY_TEXT = "ISC INITIATIVE"

        MY_FONT = ImageFont.truetype("verdanab.ttf", 11)
        MY_SIZE = MY_FONT.getsize(MY_TEXT)

        MY_IMG = Image.new("1",MY_SIZE,"black")
        DRAW_FUNC = ImageDraw.Draw(MY_IMG)
        DRAW_FUNC.text((0, 0), MY_TEXT, "white", font=MY_FONT)

        PIX_RES = np.array(MY_IMG, dtype=np.uint8)
        CHAR_RES = np.array([' ','#'], dtype="U1")[PIX_RES]

        STR_RES = CHAR_RES.view('U' + str(CHAR_RES.shape[1])).flatten()
        print("\n".join(STR_RES))

    except:

        pass
```

c_import.py

```
"""
(cc) Creative Commons / 2020-2021 ISCI - LAB DEVELOPERS
We are an initiative that conducts studies in the field of Space Science, publishes projects and reports, offers analytical perspectives and data ana
We believe that science changes the future.
initiative.isc@protonmail.com
initiative.isc@tutanota.com
"""

from __future__ import print_function

try:

    from PIL import Image, ImageDraw, ImageFont
    from optparse import OptionParser
    import requests
    from bs4 import BeautifulSoup
    import sys
    import time
    import numpy as np
    import warnings

    warnings.filterwarnings(action="ignore",message="CHECK PYTHON VERSION")
    warnings.filterwarnings(action="ignore",message="ALREADY IMPORTED",category=UserWarning)
```

C_local_alert:

```
def get_local_based(search_parameters=str,count_search=int):

    TARGET_URL = f"https://severeweather.wmo.int/{search_parameters}/"

    try:

        TAR_REQ = requests.get(TARGET_URL).text
        BS_REQ = BeautifulSoup(TAR_REQ,"html.parser")

        Area_ALL = BS_REQ.find_all("area")

        i_count_stop = 0

        for x_loop_area in Area_ALL:

            HREF_ALL_AREA_PATH = x_loop_area.get("href")
            REP_DOT_RAIN = HREF_ALL_AREA_PATH.replace("./","")
            ALL_PATH_RAIN = TARGET_URL + REP_DOT_RAIN

            NEW_TAR_REQ = requests.get(ALL_PATH_RAIN).text
            BS_NEW_TAR = BeautifulSoup(NEW_TAR_REQ,"html.parser")
            AREA_NEW_ALL = BS_NEW_TAR.find_all("area")
```

C_nasaoent.py:

```
def get_nasa_eonet(count_search=int):

    TEST_SPEC_TARGET_URL = "https://eonet.sci.gsfc.nasa.gov/api/v3/events"

    try:

        READ_URL = requests.get(TEST_SPEC_TARGET_URL)
        READ_JSON = READ_URL.json()

        EVENTS_JSON = READ_JSON["events"]


        for x_range in range(count_search):


            EVENT_TITLE = EVENTS_JSON[x_range]["title"]
            EVENT_DATE = EVENTS_JSON[x_range]["geometry"][0]["date"]
            EVENTS_LAT = EVENTS_JSON[x_range]["geometry"][0]["coordinates"][1]
            EVENTS_LON = EVENTS_JSON[x_range]["geometry"][0]["coordinates"][0]

            time.sleep(0.8)
            print("\n")
            print("TITLE: ",EVENT_TITLE)
```

c_seismic.py:

```
def get_seismic_data(count_search=int):

    TARGET_REQ_URL = f"https://www.seismicportal.eu/mtws/api/search?&format=json&downloadAsFile=false&orderby=tim

    try:

        READ_URL = requests.get(TARGET_REQ_URL)
        READ_JSON = READ_URL.json()

        for x_num in range(len(READ_JSON)):

            NEW_JSON = READ_JSON[x_num]

            time.sleep(0.8)
            print("\n")
            print("REGION: ",NEW_JSON["ev_region"])
            print("LATITUDE: ",NEW_JSON["ev_latitude"])
            print("LONGITUDE: ",NEW_JSON["ev_longitude"])
            print("DEPTH: ",NEW_JSON["ev_depth"])
            print("MAGNITUDE VALUE: ",NEW_JSON["ev_mag_value"])
            print("MAGNITUDE TYPE: ",NEW_JSON["ev_mag_type"])
            print("EVENT TIME: ",NEW_JSON["ev_event_time"])
            print("FULL COUNT: ",NEW_JSON["full_count"])
```

C_valcano_g:

```
def get_volcano(count_search=int):

    try:

        GDACS_TARGET = requests.get("https://www.gdacs.org/default.aspx").text
        SOUP_GDACS = BeautifulSoup(GDACS_TARGET,"html.parser")
        ALL_V_DISASTER = SOUP_GDACS.find_all("div",id="mainListVo")
        CONTROL_VALUE_LIST = []
        i_count_stop = 0


        for x_att in ALL_V_DISASTER:

            ALERT_DETAIL_LINK = x_att.find_all("a")

            for x_detail_link in ALERT_DETAIL_LINK:

                LINK_AFTER_SITE = str(x_detail_link.get("href"))

                SUB_TARGET = requests.get(LINK_AFTER_SITE).text
                SOUP_TARGET = BeautifulSoup(SUB_TARGET,"html.parser")
                SUB_TARGET_DIV = SOUP_TARGET.find_all("div",id="alert_summary_left")
```

C_valcano_alternative:

```
def get_alternative_volcano():

    TARGET_REQ_URL = "https://volcano.si.edu/news/WeeklyVolcanoRSS.xml"

    try:

        REQ_TARGET = requests.get(TARGET_REQ_URL).text
        SOUP_TARGET = BeautifulSoup(REQ_TARGET,"html.parser")

        FIND_ALL_ITE = SOUP_TARGET.find_all("item")


        for x_loop in FIND_ALL_ITE:

            TITLE_OUT = x_loop.find("title")
            DES_OUT = x_loop.find("description")
            COOR_OUT = x_loop.find("georss:point")

            time.sleep(0.8)
            print("\n")
            print("TITLE: ",TITLE_OUT.text)
            print("DESCRIPTION: ",DES_OUT.text.replace("<p>","").replace("</p>",""))
```

12.2 GitHub & Project Demo Link

- Our GitHub Repository Direct Link
  https://github.com/IBM-EPBL/IBM-Project-28626-1660114526
- Project Demonstration Video Direct Link
  https://www.youtube.com/watch?v=O50QGyg0BGQ