

Software Requirements Specification

for

Forewarning System About Natural Calamities

Version 2.0

Prepared By

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1 Introduction

1.1 Purpose

This problem statement highlights the ‘*complexities of utilizing historical data on various triggering parameters and signals associated with natural calamities to forecast future events*’. The overarching goal is ‘*to enhance disaster preparedness and response efforts by leveraging historical data effectively*’.

The purpose is to develop robust methodologies for utilizing historical data to enhance disaster preparedness and response efforts globally. This requires collaboration across disciplines and sectors to ensure that historical data is effectively leveraged to mitigate the impact of natural disasters.

1.2 Document Convention

IEEE Std 830-1998, *IEEE Recommended Practice for Software Requirements Specifications*. IEEE Computer Society, 1998.

Some standards:

- Size: 12(Text), 16(Sub-title) and 18(Title)
- Font: Times New Roman
- Left Margin: 1.38
- Right Margin: 1.25

1.3 Stakeholders

Various users and stakeholders involved in disaster preparedness, response, and recovery are:

Government Agencies and Emergency Services:

- Government agencies responsible for disaster management and emergency services can leverage these systems to enhance their decision-making processes.
- Early warnings enable better resource allocation, evacuation planning, and coordination of response efforts.

Local Communities:

- Residents in disaster-prone areas can receive timely and accurate alerts, allowing them to evacuate or take precautionary measures well in advance.
- Community leaders can use the information to organize community drills and prepare residents for potential disasters.

Humanitarian Organizations:

- Non-governmental organizations (NGOs) and humanitarian groups can use advanced forewarning systems to plan and execute relief operations more effectively.
- Predictive analytics helps in positioning resources, mobilizing aid, and responding promptly to affected areas.

1.4 Product scope

This research focuses on exploring the potential of combining historical data with machine learning (ML) techniques to improve the accuracy and effectiveness of natural disaster prediction and early warning systems.

Scope definition:

1. *Types of disasters*
2. *Geographical scope*
3. *Data utilization*
4. *ML algorithms*
5. *Forewarning system development*
6. *Evaluation and impact assessment*

Exclusions:

- This research will not delve into the social, economic, and political aspects of disaster management, focusing primarily on the technical aspects of prediction and early warning systems.
- Optimization of specific ML algorithms and deep learning architectures may fall outside the scope based on resource constraints and project timelines.

1.5 References

1. Maria Drakaki, Yannis Karnavas, “Machine Learning in Disaster Management: Recent Developments in Methods and Applications”. Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University (September, 2022).
2. Mahalakshmi Selveraj, Kuppuswamy Sunitha, “Forecasting, forewarning weather and disasters in the social web: A network study.”. Department of Media Sciences, Faculty of Science and Humanities, Anna University, (November, 2018).

2 Requirement Specification

2.1 External Interface Requirements

We would need a combination of software tools and frameworks. Here is a suggested set of software requirements:

2.1.1 Machine Learning libraries and frameworks

TensorFlow: A machine learning framework developed by Google.

PyTorch: A deep learning framework widely used for research and production.

Scikit-learn: An efficient tool for data analysis and machine learning in Python.

Keras: It is an open-source library that provides a Python interface for artificial neural networks.

2.1.2 Data Processing and Analysis

Pandas: A powerful data manipulation and analysis library for Python.

NumPy: Fundamental package for scientific computing with Python.

SMOTE: It is a preprocessing technique used to address a class imbalance in a dataset.

Power BI: For user analytics and insights

2.1.3 Data Visualization

Matplotlib: A 2D plotting library for Python.

Seaborn: Built on top of Matplotlib, Seaborn provides a high-level interface for drawing attractive and informative statistical graphics.

mpld3: Matplotlib to D3.js converter

2.1.4 Database Management

SQLite, *MySQL*, or other relational databases for storing and managing historical datasets.

2.1.5 Web Development

Flask or Django: Python web frameworks for building web applications if your system requires a web interface.

JavaScript: Backend development

2.1.6 Cloud Services

Google Cloud Platform: Depending on project requirements, cloud services can be used for scalable and distributed computing

2.2 Functional Requirement Specification

This section outlines the use cases for each admin and user respectively

2.2.1 Administrator Use Case

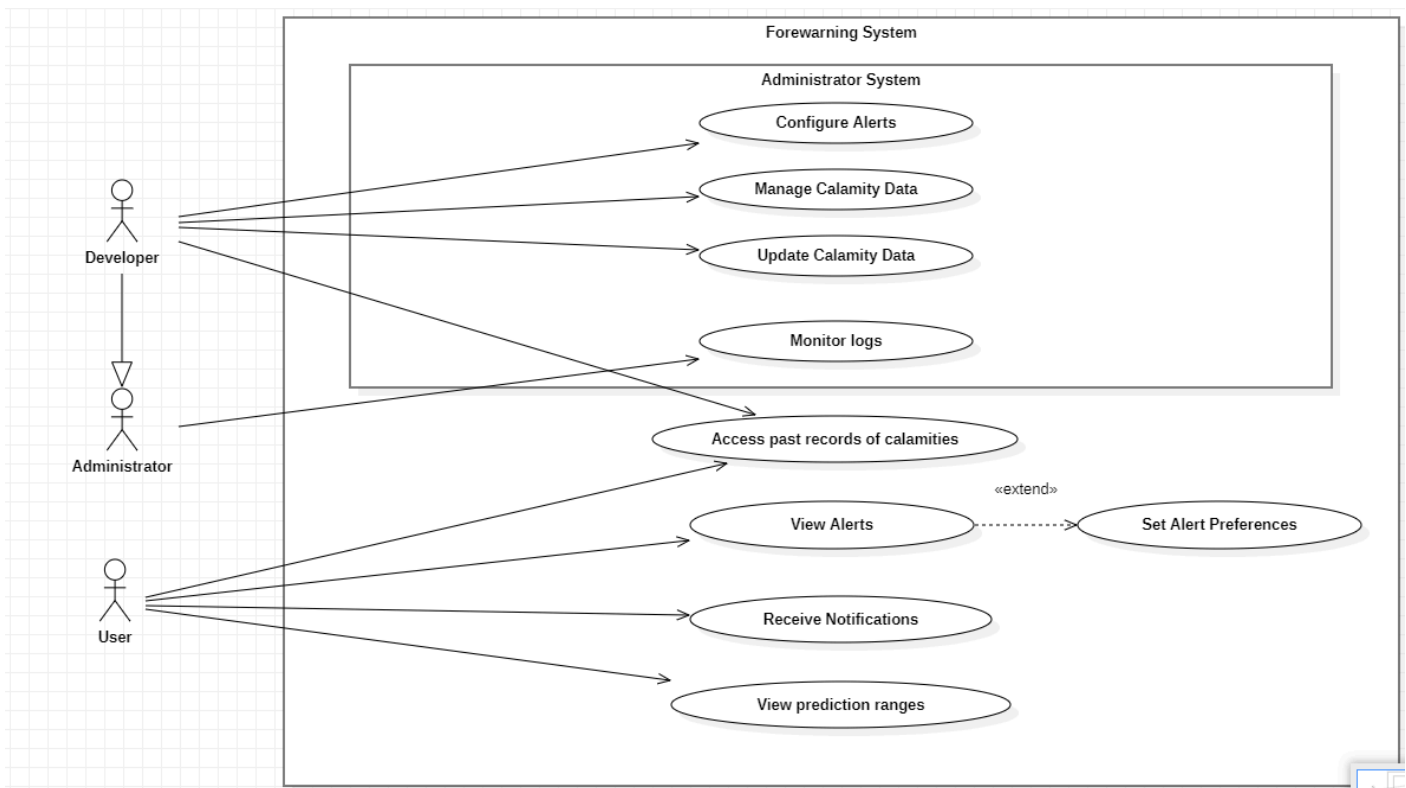
Brief Description

The administrator can monitor the status of website

2.2.2 User Use Case

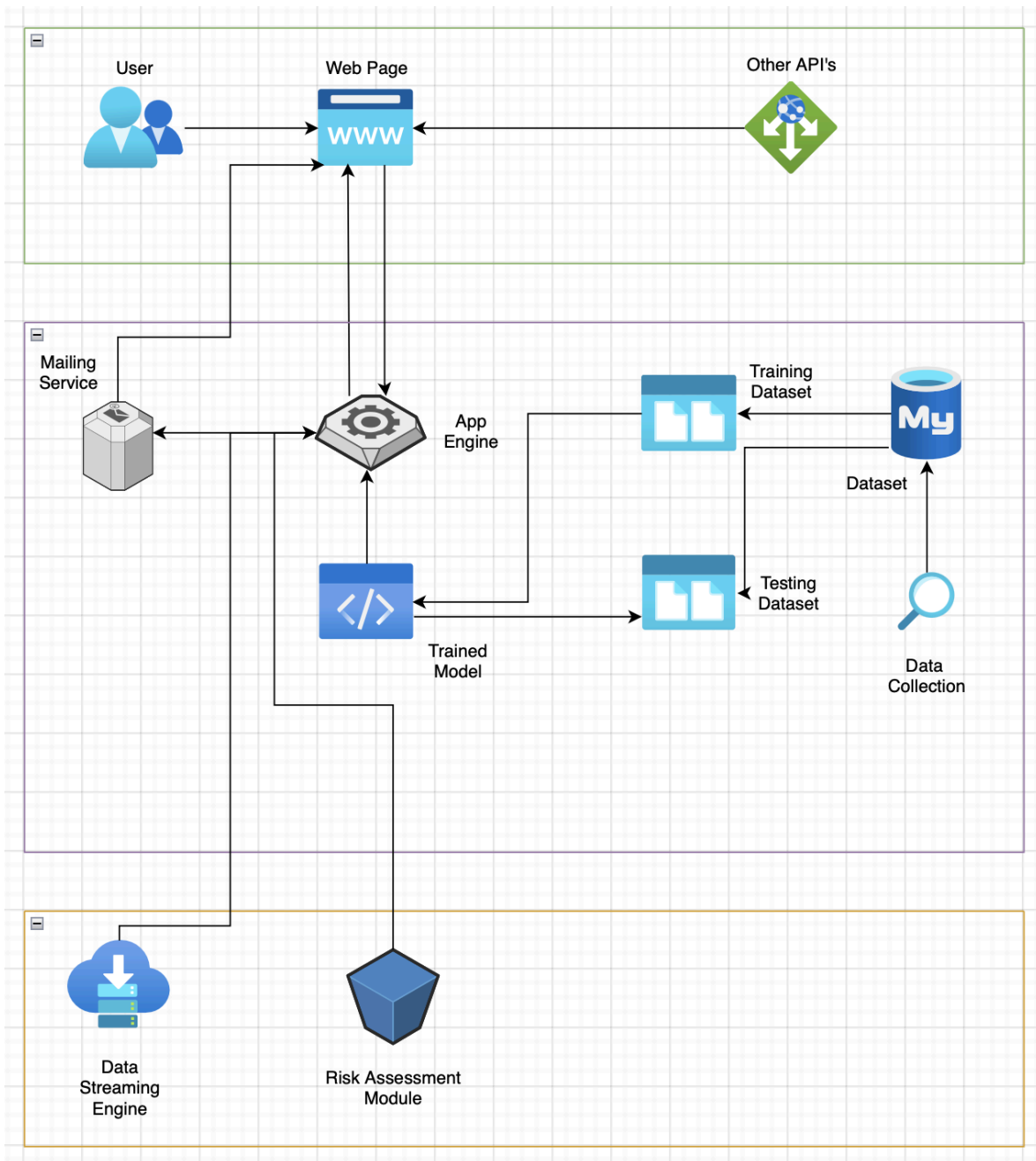
Brief Description

The user is notified by alert if any upcoming warning persists



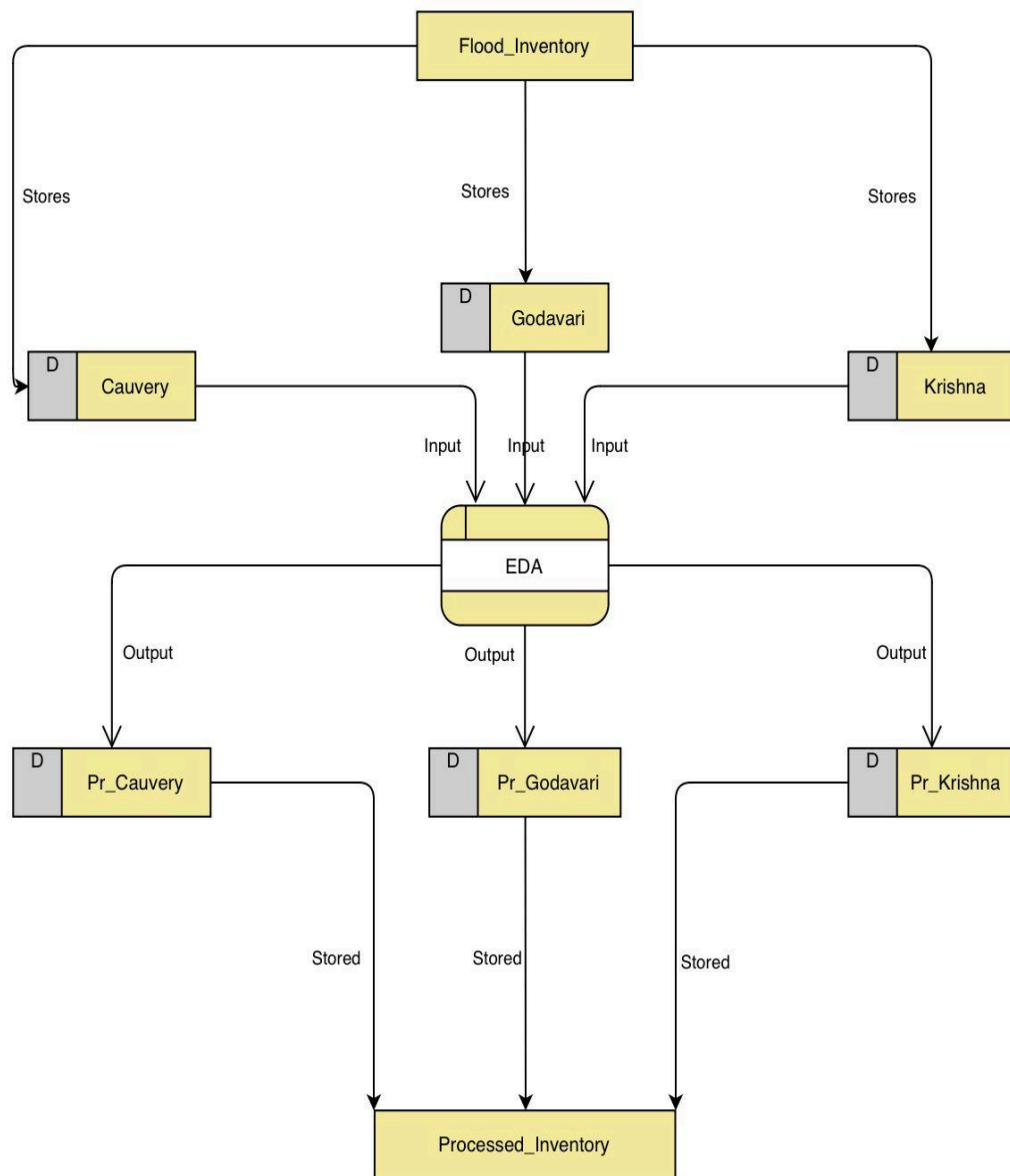
3 Other Non-Functional Requirements

3.1 Architecture Diagram

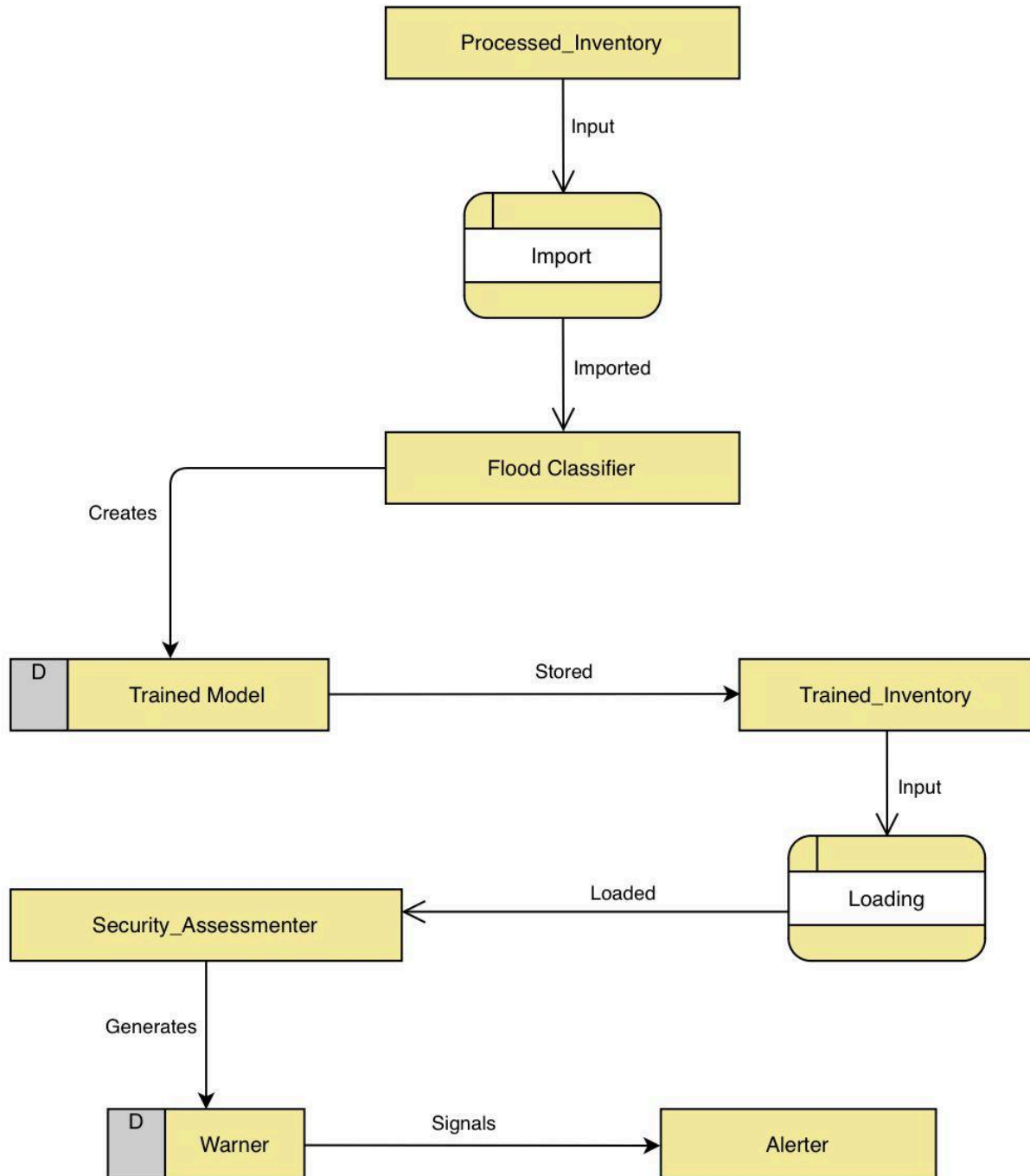


3.2 Data Flow Diagram

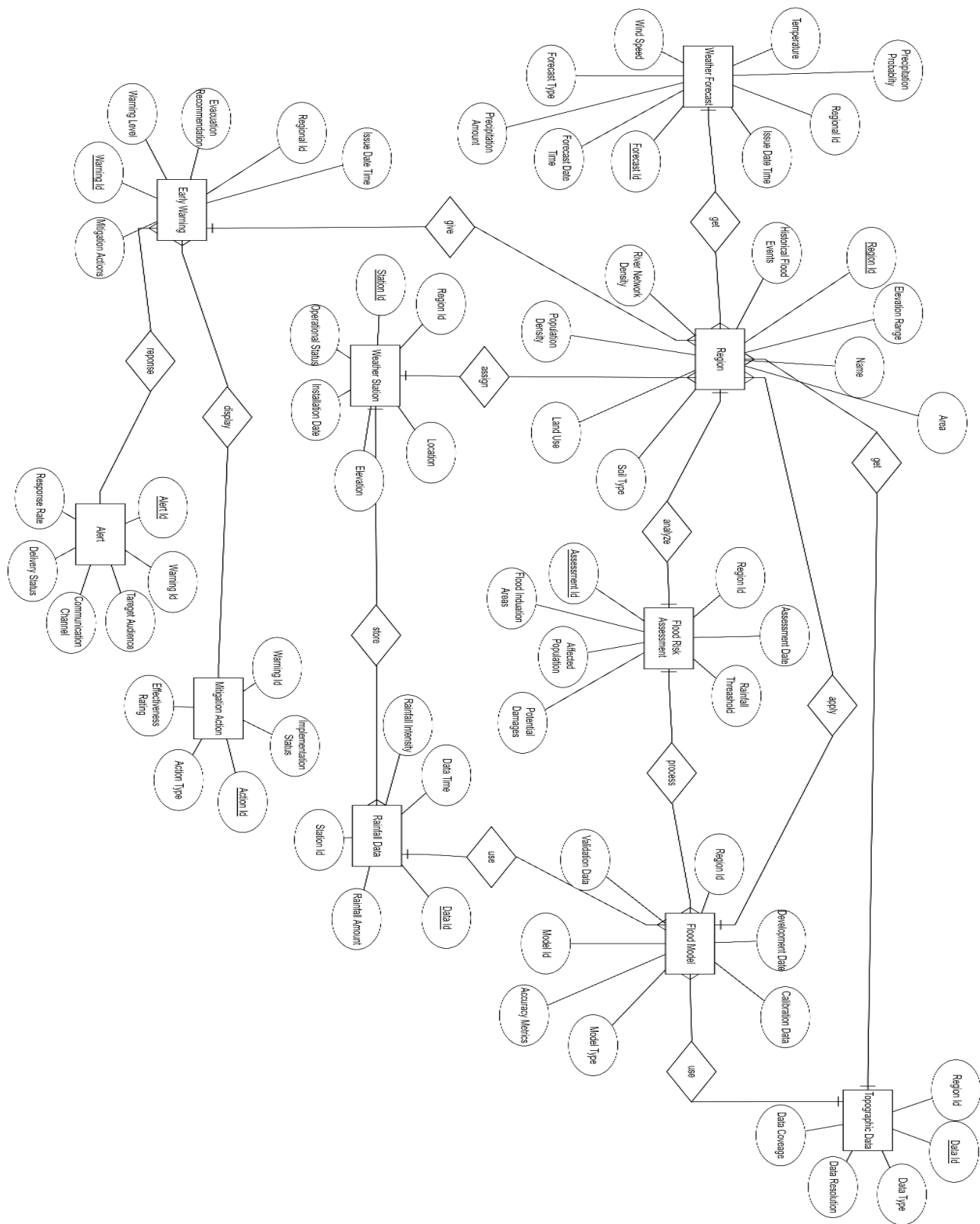
3.2.1 For a specific disaster



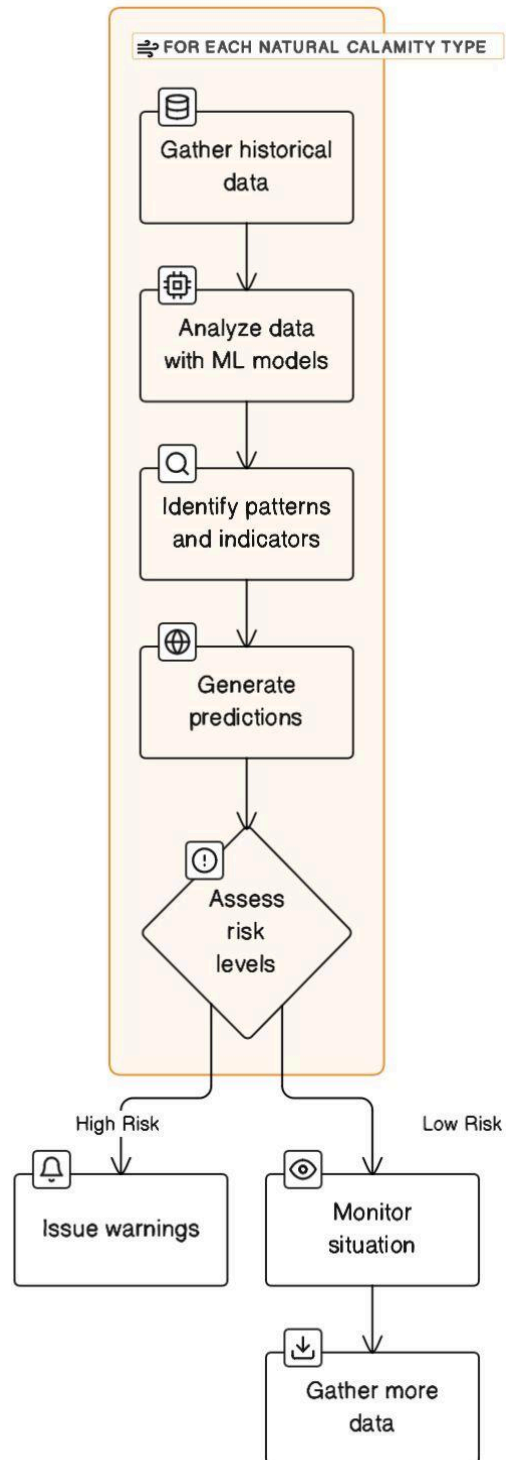
3.2.2 Module Connectivity



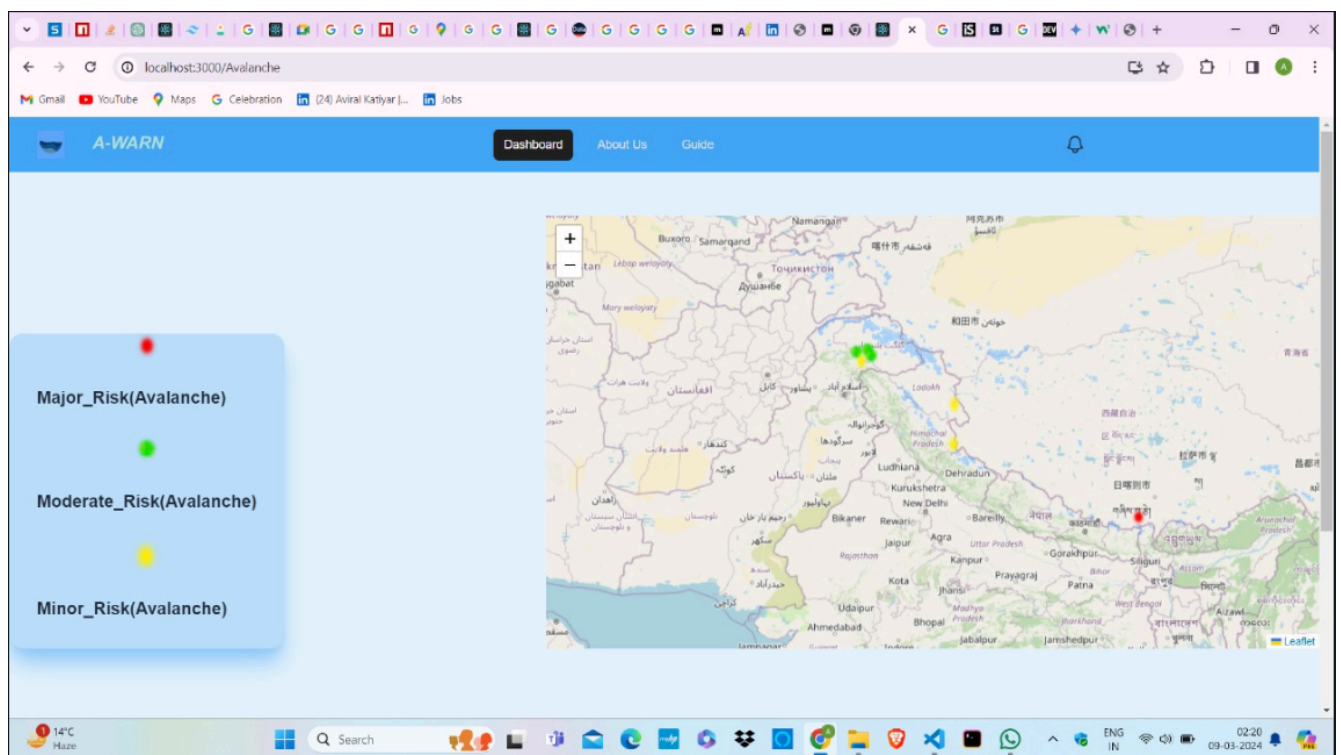
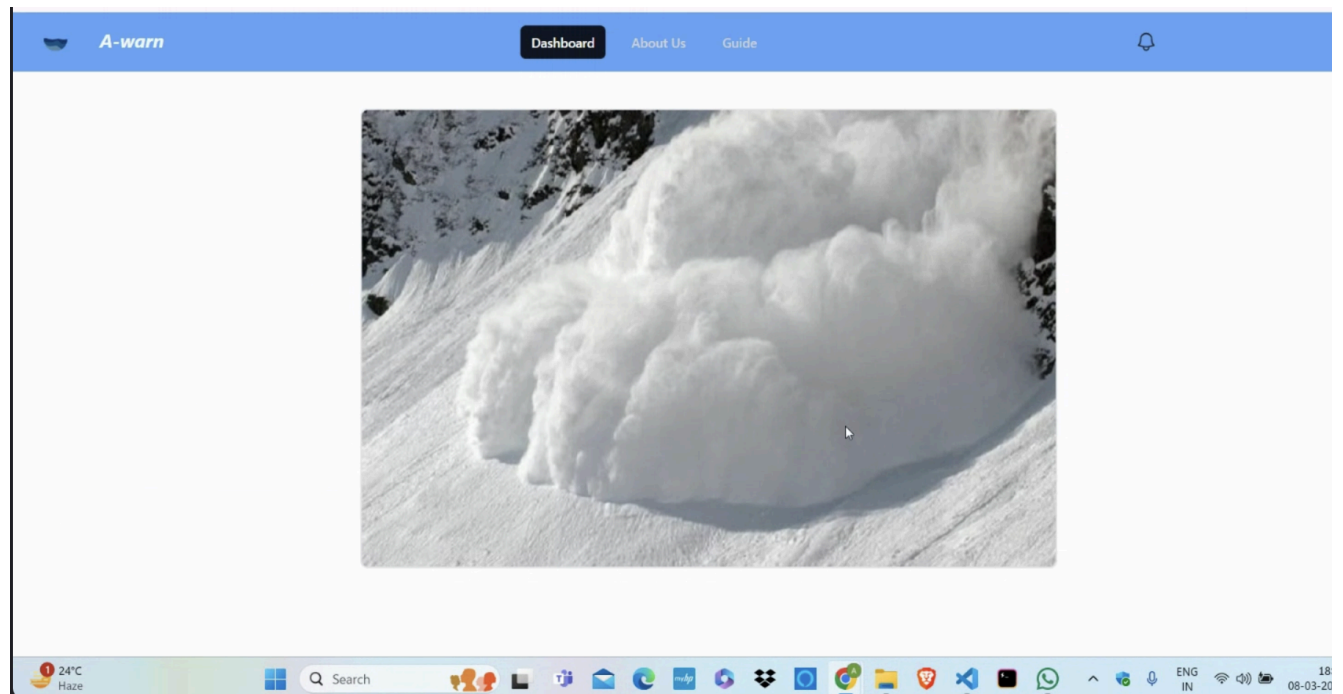
3.3 ER Diagram

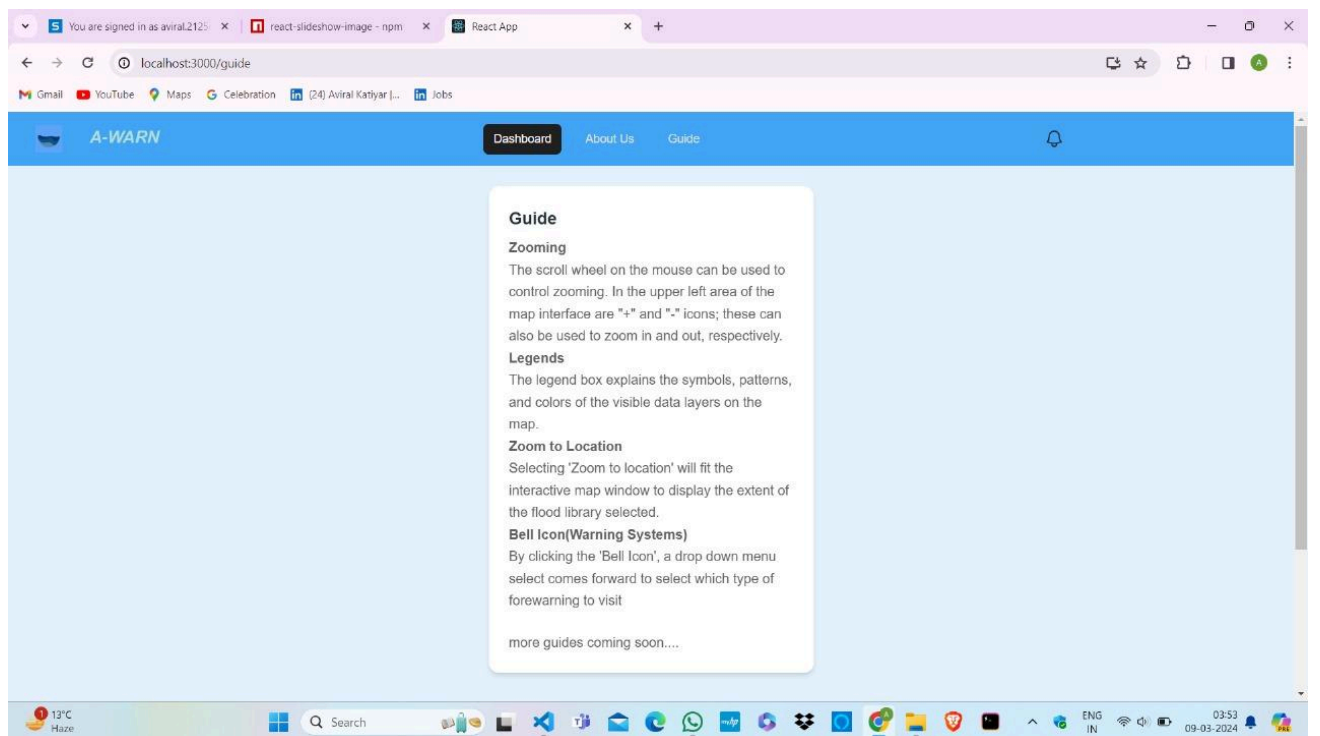
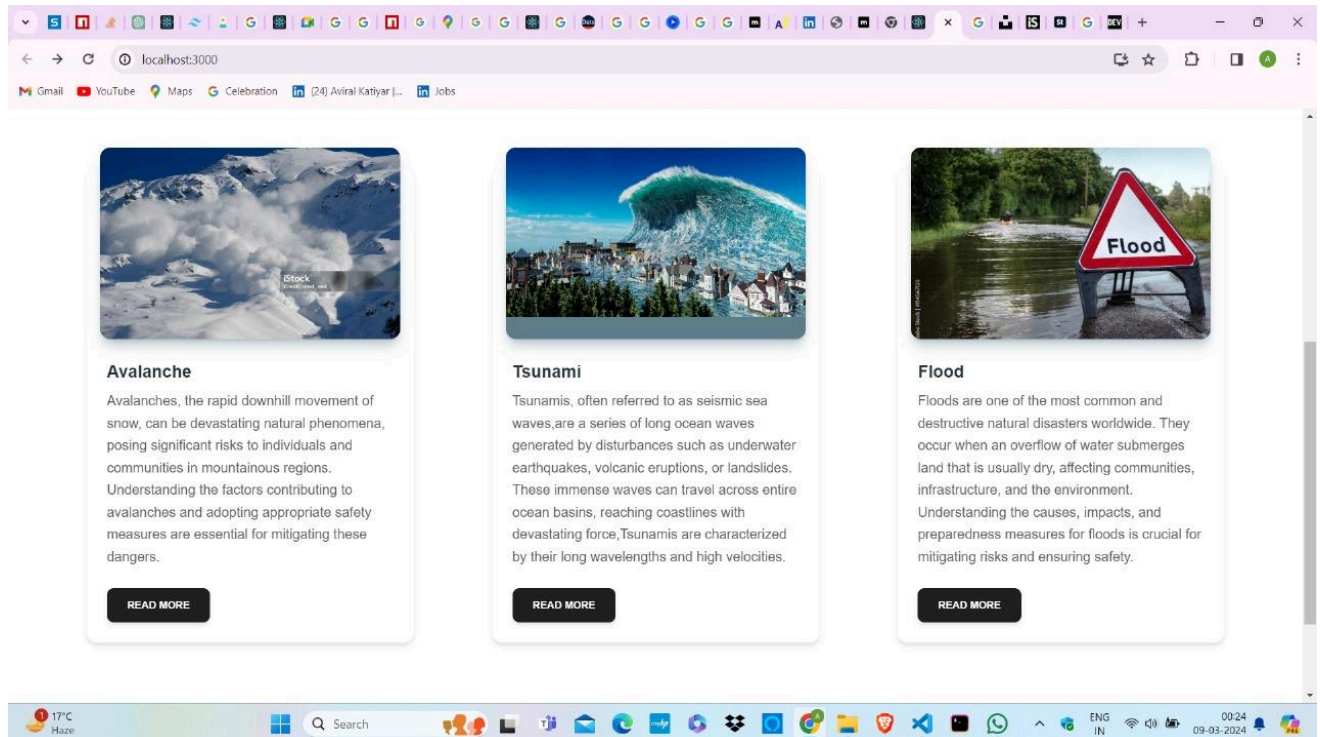


3.4 Communication Interfaces



3.4 Visual Design





Appendix A : Glossary

- 1.) **Forewarning System:** A software system designed to monitor, forecast, and alert individuals or organizations about impending natural calamities such as earthquakes, floods, hurricanes, etc.
- 2.) **Natural Calamities:** Catastrophic events caused by natural forces, including but not limited to earthquakes, tsunamis, hurricanes, tornadoes, floods, wildfires, and volcanic eruptions.
- 3.) **Alert:** A notification issued by the forewarning system to warn individuals or communities about an imminent or ongoing natural calamity, providing relevant information and safety instructions.
- 4.) **Administrator:** A user role within the forewarning system responsible for managing user accounts, configuring alerts, monitoring system status, and managing calamity data.
- 5.) **User:** An individual or organization registered within the forewarning system to receive alerts and access information related to natural calamities.
- 6.) **Alert Preferences:** User-defined settings that specify how alerts should be delivered (e.g., email, SMS, push notifications) and which types of calamities to receive alerts for.
- 7.) **Calamity Data:** Information related to past, present, or predicted natural calamities, including parameters such as location, severity, duration, and impact.
- 8.) **Data Management:** Processes and procedures for storing, organizing, updating, and accessing calamity data within the forewarning system.
- 9.) **User Interface:** The graphical or interactive interface through which users interact with the forewarning system to request alerts, view information, and configure settings.
- 10.) **Communication Module:** The component responsible for delivering alerts to users via various communication channels, ensuring timely and reliable dissemination of information.
- 11.) **Data Retrieval:** The process of extracting relevant calamity data from the system's database in response to user requests or system operations.
- 12.) **Historical Data:** Data stored within the system that records past occurrences of natural calamities, providing a basis for analysis, research, and trend identification.

- 13.) **Severity:** A measure of the intensity or magnitude of a natural calamity, often categorized based on the level of impact on human life, property, and the environment.
- 14.) **Emergency Response:** The coordinated efforts and actions taken by individuals, communities, and authorities in response to natural calamities, aimed at mitigating risks, ensuring safety, and facilitating recovery.