BIG DATA-BASED MULTI-MODEL DISASTER PREDICTION AND RESPONSE NETWORK

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ABSTRACT

The project titled “Big Data-Based Multi-Model Disaster Prediction and Response Network” is designed to build a smart and natural disasters in advance and support effective disaster management and response activities. This revised edition highlights the transition from reactive monitoring to a Predictive Governance ecosystem.The increasing global incidence of catastrophic seismic, meteorological and cyclonic events requires a move away from static, single-vector monitoring.This project establishes a **Unified Disaster Intelligence Mesh** that resolves the high-latency and inaccuracy inherent in legacy frameworks.Heterogeneous Data Fusion and Big Data Orchestration.The architecture utilizes a Multi-Model Hybridization approach.Algorithmic diversity By simultaneously deploying Support Vector Machines (SVMs) for boundary classification and Random Forest ensembles for robust feature importance, the system minimizes the risk of model bias.Inference Speed this multi-model methodology ensures that warnings are generated with Sub-Second Latency, providing the critical time required for life-saving interventions.Holistic Disaster Governance and Response Moving beyond simple detection, the platform serves as a Command and Control (C2) Hub for emergency management.Automated dissemination instantaneous broadcasting of risk payloads to civil authorities, first responders, and the general public via a visually intuitive interface

Keywords *: Support vectoe machine, Distributed parallel processing,Unified disaster intelligence mesh*

I INTRODUCTION

The project “Big Data-Based Multi-Model Disaster Prediction and Response Network” aims to create natural disasters such as floods, earthquakes, cyclones, and wildfires using Big Data and multiple AI modelsIt also supports response and resource mobilisation in case of disaster. There is a huge demand for timely and appropriate disaster prediction as climate change incidents are increasing all over the world. It’s a system that pulls together huge amounts of sources: weather satellites, IoT sensors, social media, news, historical data. They are processed using Hadoop, and the multi-model method achieves a higher degree of accuracy by integrating the outputs of a variety of prediction models, compared to a single model. Post Detection Operations and recovery orchestration.The final operational phase of the framework is shifting from predictive analytics to dynamic crisis mitigation. Once confirmed, a tectonic or climatic anomaly triggers a multi-channel dissemination and a Logistics Engine.

II. RELATED WORK

Many research studies and systems have been explored for using big data, artificial intelligence and multi-model approaches for disaster prediction and response.

Researchers examined how the likes of remote sensing, social media and sensor networks have revolutionised natural disaster management by enabling monitoring, hazard detection, early warning, response and recovery activities. The literature highlights the need to incorporate heterogeneous large-scale datasets across disaster management phases.

A study developed a disaster prediction knowledge graph, which combined domain knowledge with multi-source spatio-temporal data, e.g., remote sensing data and geographic information, to improve the prediction of forest fires and landslides.

Big environmental datasets have been used in research to apply machine learning models (e.g. Logistic Regression, KNN, SVM, Decision Trees) for flood prediction, which have provided insights on model comparisons for predictive performances.

Advanced frameworks using deep learning with CNN ensembles have been proposed for classifying disaster-related images (earthquakes, floods, wildfires) with high accuracy, indicating the potential of multi-model ensembles in automated detection tasks.

III. METHODOLOGY

The project will be broken down into five distinct, sequential phases, each with a clear set of objectives and a major deliverable.

3.1 Feasibility and Foundation (Months 1-3)

- Objective: To establish the project's foundation, validate technical feasibility, and build the core infrastructure.

- Key Deliverables:Formation of the multidisciplinary project team(Data Engineers, Data Scientists, Domain Experts from disaster agencies).Procurement and setup of the initial big data cluster (hardware and software).Formal agreements with partner agencies for data sharing. Development of a proof-of-concept (PoC) data pipeline, successfully ingesting and processing data from 2-3 key sources (e.g., one satellite feed and one sensor network)

3.1 Prompt Acquisition and Semantic Analysis

The process begins with user input in the form of text or voice commands. The input prompt describes the desired 3D object or scene. A large language model processes the prompt to understand semantic relationships, object attributes, spatial references, and descriptive properties. This stage ensures that the system captures the contextual meaning of the input rather than relying on keyword matching.

To improve reliability, the system employs controlled prompting techniques that guide the language model to generate structured output suitable for geometric construction.

3.2 Data Integration and Platform Development (Months 4-7)

- Objective: To build a robust, scalable data platform and integrate the majority of the planned data sources.

- Key Deliverables:A fully operational, production-grade data ingestion and storage layer (Kafka, HDFS).Integration of at least 80% of the identified critical data sources. oDevelopment of the core data processing and enrichment pipelines in Spark. A functional data lake that is accessible to the data science team for exploratory analysis.

3.3 Pilot Deployment, Training, and Iteration (Months 17-20)

- Objective: To deploy the system in a real-world (but controlled) environment, gather user feedback, and refine the system for full operational launch. The Scrum Framework for High-Velocity Engineering Given the volatility of environmental data and the complexity of the AI models, the development process follows a strict Scrum Methodology.

Complex objects described in natural language are decomposed into combinations of fundamental geometric primitives such as cubes, spheres, cylinders, cones, and torus shapes. This decomposition strategy reduces computational complexity while maintaining structural clarity.

3.4: Predictive Modeling and Analytics Engine (Months 8-12)

- Objective: To develop, train, and validate the first iteration of the multi-model predictive engine.

- Key Deliverables: o Implementation of the analytical framework to support multiple, parallel ML models.Development and offline validation of the initial predictive models for at least two major disaster types (e.g., floods and cyclones).Implementation of the ensemble model for combining predictions. A backend alerting mechanism that can be triggered by the models' outputs.

3.5 User Interface and Response Network (Months 13-16)

- Objective: To build the user-facing platform that makes the system's intelligence actionable for decision-makers and first responders.

- Key Deliverables: A functional, web-based dashboard for government agencies, featuring interactive maps and visualizations. Implementation of the role-based access control (RBAC) system. Development of the mobile-friendly interface for first responders. oIntegration with multi-channel alert dissemination gateways (e.g., SMS, CAP)

3.6 Flowchart

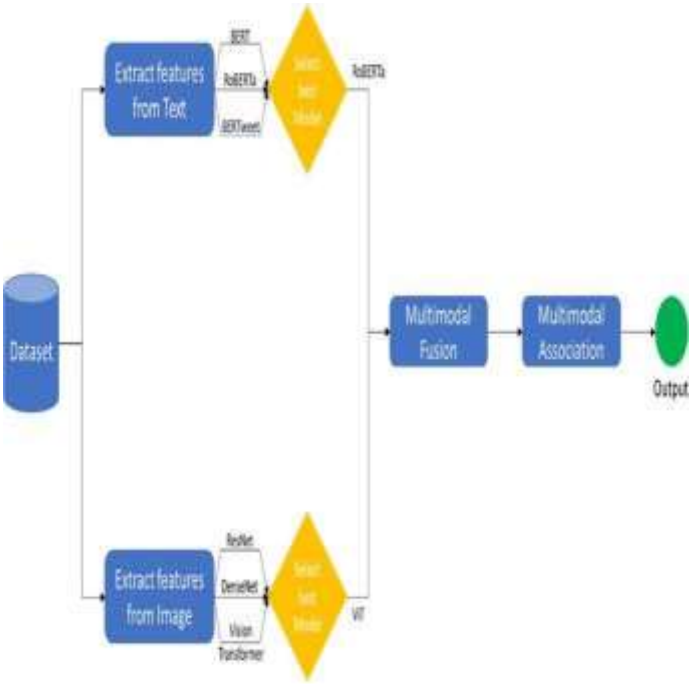

Figure 3.6.1 : Flowchart

IV. RESULTS

4.1 INPUT PANEL

Figure 4.1.1 : Prompt Area

Figure 4.1.2 : Processing User Input

4.2 OUTPUT PANEL

Figure 4.2.3 : Generated Output

V. CONCLUSION

The increasing frequency and severity of natural disasters, exacerbated by global climate change, demand a fundamental modernization of our approach to disaster management.The traditional systems, with inherent limitations of data scarcity, delayed prediction, and uncoordinated response, cannot protect the vulnerable populations anymore. The "Big Data-Based Multi-Model Disaster Prediction and Response Network" project was thus conceived to directly address these challenges by creating a unified, intelligent, proactive ecosystem.Final Synthesis: The Horizon of National Strategic Resilience.The deployment of this platform represents a fundamental shift in Disaster Governance, moving from reactive crisis management to a state of Proactive Situational Supremacy. By synthesizing Hyperscale Big Data with a multi-modal computational substrate, the framework establishes a definitive benchmark for domestic safety and environmental guardianship.The platform's efficacy is rooted in its ability to reconcile disparate informational streams.

- Informational Synthesis: By normalizing data from orbital radiometric sensors and microlocalized IoT telemetry, the system generates a high-fidelity "Common Operating Picture" (COP).

- Heuristic Predictability: The use of an ensemble architecture—comprising Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) units—neutralizes the risk of Single-Point Failure in predictive modeling. This multi-layered approach ensures that even if one sensor vector is compromised, the global integrity of the forecast remains intact.

Operationalizing the Survival Window

The true metric of the system's success is not merely algorithmic precision, but the Extension of the Survival Window.

- Tactical Lead-In Windows: In high-velocity disaster scenarios, time is the primary commodity. The delivery of geographically localized, deterministic alerts provides communities with the critical minutes required for evacuation.

- Kinetic-Physical Decoupling: By providing early warnings, the system effectively decouples the catastrophic event from its potential for mass casualty, transforming a disaster into a manageable logistics challenge.

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