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Advanced Global Safety with Precision Disaster Prediction and Early Warning Systems Using H-PReADS Models

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Abstract— Disaster management is a significant worldwide concern that needs precise, real-time predictive models to successfully limit hazards. Conventional methods are ineffective for processing dynamic, high-dimensional disaster data, leading to delayed responses and heightened fatalities. This paper presents H-PReADS (Hybrid forecast Analytics for Disaster Surveillance), an AI-based system utilising LSTM, CNN, XGBoost, and IoT-enabled real-time monitoring to improve forecast accuracy and disaster readiness. The model surpasses traditional methods, with 98.5% accuracy, 97.2% precision, 96.8% recall, and a 0.99 ROC-AUC score, indicating enhanced robustness. compared to current systems, H-PReADS integrates multi-source sensor data, guaranteeing real-time adaptability and superior generalisation capability. Significant contributions encompass hybrid AI architecture, real-time sensor integration, and the development of ethical AI. These findings position H-PReADS as an innovative method for proactive disaster response. Future research will investigate blockchain-secured data interchange and federated learning-based distributed intelligence to improve scalability and security.

Keywords— Disaster prediction, Hybrid machine learning, IoT-based monitoring, Deep learning, LSTM, CNN, XGBoost, Real-time data analytics, Risk assessment, Emergency response, Sensor networks, Federated learning, Blockchain security, Data privacy, Explainable AI, Scalability, and Disaster resilience.

I. INTRODUCTION

The rising frequency and severity of natural disasters, including floods, earthquakes, and wildfires, have highlighted the failings of conventional disaster prediction models. Traditional methods exhibit insufficient real-time flexibility, encounter difficulties with varied sensor data, and do not deliver early risk evaluations with high precision. Current methodologies primarily depend on historical data analysis, which is insufficient for the continuously developing nature of catastrophe scenarios. The lack of real-time sensor fusion restricts their reactivity, resulting in delayed emergency actions and heightened fatalities. To rectify these drawbacks, sophisticated hybrid AI-driven models are necessary to incorporate IoT-enabled real-time monitoring, deep learning-based pattern identification, and intelligent risk assessment algorithms. The study highlights the effects of natural and manmade disasters on society and indicates mitigation techniques across sectors such as engineering, economics, and management [1]. It recognises active and passive mitigation strategies but fails in advanced predictive modelling. Our study overcomes this gap by employing H-PReADS for accurate disaster prediction. The study analyses national disaster risk reduction (DRRR) plans within the Sendai Framework [2], focussing challenges such as policy silos and power conflicts. It is inadequate in technological integration and predictive modelling, which our model aims to improve for enhanced disaster preparedness and resilience. This research illustrates the integration of disaster risk reduction with human development [3]. It recognises policy and cross-sector coordination as essential, however it lacks forecasting precision. Our methodology addresses this inconsistency with real-time, data-informed disaster forecasts. This study links risk perception to disaster risk reduction (DRR) with safety culture, highlighting historical and management perspectives [4]. Although it considers behavioural elements, it is poor in modern technical frameworks. Our model improves disaster risk reduction through accurate, AI-driven disaster prediction capabilities. This study examines goaf disaster research [5], categorising it into embryonic and rapid development phases. It indicates four study domains detection, analysis, risk assessment, and treatment highlighting the impacts of deep mining. Still, it is limited in predictive modelling accuracy, which our model improves for superior prediction. The study analyses disaster risk reduction research from 1990 to 2019 [6], revealing a 3% annual growth rate and highlighting technologies such as GIS, remote sensing, and disaster insurance. Despite technology identification, it lacks significant AI integration, which our model fixes for accurate disaster forecasts. This study examines digital technologies in landslip management, focussing on risk identification and improvements in artificial intelligence [7]. It draws attention to the observation of progress from aerial to terrestrial sensors but fails in integrated forecasting models. The H-PReADS model enhances the precision of disaster forecasting in many