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Deep Learning for Disaster Detection: A Framework for Automated Multimodal Data Classification

Nandhakumar C
Department of Computer Science and Engineering
M.Kumarasamy College of Engineering,Thalavapalayam
Karur,Tamilnadu,India .
nandhakumarc.cse@mkce.ac.in

MarkElfric J
Department of Computer Science and Engineering
M.Kumarasamy College of Engineering,Thalavapalayam
Karur,Tamilnadu,India
markj27032004@gmail.com

Maruthanayagam S
Department of Computer Science and Engineering
M.Kumarasamy College of Engineering,Thalavapalayam
Karur,Tamilnadu,India
marudhanayagamdurga2003@gmail.com

Naveenkumar G
Department of Computer Science and Engineering
M.Kumarasamy College of Engineering,Thalavapalayam
Karur,Tamilnadu,India
gunasekarannaveenkumar255@gmail.com

Sudharson T
Department of Computer Science and Engineering
M.Kumarasamy College of Engineering,Thalavapalayam
Karur,Tamilnadu,India
sudharson0608@gmail.com

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***Abstract*— Natural disasters such as earthquakes, floods are becoming more frequent and severe due to climate change and urban expansion. The ability to quickly detect and assess the severity of such events is necessary requirements for timely disaster response and mitigation. Traditionally, disaster detection relied on isolated data sources like weather reports, seismic sensors, and ground reports. However, the availability of multi-modal data has opened up opportunities for more holistic monitoring systems in disasters. Traditional disaster detection methods remain limited by sheer volumes and complexity, making automated systems a necessity for real-time analysis. This project will explore the concepts of deep learning frameworks for automating classification and analysis of multimodal data for disaster scenarios. DL, deep learning, with powerful tools automatically examines and classifies such enormous heterogeneity in a vast data field. Therefore, from the perspective of DL algorithms and architectures, extraction of meaningful patterns from multimodal data becomes feasible towards rapid and correct disaster detection.**

Keywords*— Disaster detection, Multimodal data, Machine studying, Deep learning, Neural networks.

I. INTRODUCTION

Disasters, whether they are natural or human-induced, can strike without any warning and may cause widespread destruction. Efficient and timely classification of disasters is an important aspect of disaster management and response, as it allows authorities to mobilize resources, provide early warnings, and initiate recovery efforts. Disaster classification refers to the procedure of identifying and classifying the disaster events based on their nature, scale, and impact. Accurate classification not only helps in real-time response but also enhances post- disaster analysis, enabling better preparedness for future incidents. Floods cause heavy damage to property, transportation, and human lives annually, so it is essential to detect them in advance and react promptly to minimize their impact and save lives. Traditional methods of flood monitoring often rely on observation, which may be time-consuming, labor-intensive, and susceptible to errors, especially in large areas or in distant locations. Floods can devastate crops, contaminate soil, and disrupt food supply chains in agricultural regions, leading to food shortage and price spikes. This not only affects local livelihoods but also contributes to broader food insecurity concerns. Moreover, floodwaters can carry pollutants, chemicals, and pathogens, contaminating water sources and affecting health risks to humans and wildlife. Waterborne diseases like cholera and dysentery spread in the affected flood zones quickly, making healthcare systems fragile and already at their breaking points. Environmental damage caused by floods includes habitat loss, loss of biodiversity, and alterations to the natural ecosystem. The water from floods can remove topsoil, strip away vegetation, and reduce the quality of the water, further affecting aquatic and riparian organisms. Floodwaters and sediments may result in eutrophication and algal blooms in the receiving water bodies downstream, which could cause ecological imbalances and also affect water-dependent industries such as fisheries and tourism. Climate change increases the occurrence and severity of floods by altering precipitation patterns, increasing the probability of extreme events, and causing sea levels to rise. Melting glaciers and ice caps through rising global temperatures enhance snowmelt and glacier outburst floods in mountainous regions. Sea-level rise with storm surges heightens the threat to coastal communities and infrastructure and ecosystems, exacerbating coastal erosion and saltwater intrusion. Comprehensive approaches that encompass both structural and non-structural measures are needed for solving the multiple problems of floods. Structural measures encompass engineering solutions such as levees, flood barriers, and reservoirs, aimed at reducing flood risk and protecting vulnerable areas. Non-structural measures focus on enhancing community resilience, early warning systems, land-use planning, and ecosystem-based approaches that promote natural flood mitigation strategies like wetland restoration and forestation.

Earthquakes are one of the general public devastating natural failures, which cause defeat of life, communications damage, and significant economic impact. Real-time detection and prediction of earthquakes are critical for reducing damage