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SafeAlert: A Comprehensive Natural Disaster Management Solution using Machine Learning

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Abstract: In order to provide real-time situational insights and responsive capabilities SafeAlert is an advanced platform for disaster management that combines machine learning edge computing and geographic information systems (GIS). SafeAlert aims to enhance disaster response prediction assessment and coordination by combining these technologies. Its modular design facilitates easy scalability and customization. The platform uses well-known algorithms for accurate forecasting such as Support Vector Machines (SVM) and Recurrent Neural Networks (RNN). Communities may improve their preparedness and recovery efforts during disasters thanks to SafeAlert's user-friendly interface which facilitates visualization alert notifications and response coordination.

Keywords: *Natural Disasters, SVM, CNN, Alert Systems, Disaster Management.*

I. INTRODUCTION

Among the most destructive forces in the world natural disasters pose serious risks to infrastructure human life and ecosystems. These events which are the result of natural processes can happen suddenly and cause great destruction. Wildfires floods earthquakes tsunamis and landslides are examples of common natural disasters. Despite the fact that every variety has its own special qualities they can all quickly cause significant harm. Disaster management strategies must be effective in order to lessen their effects and enable timely responses [1].

For instance, landslides happen when rock dirt and other debris tumble down a slope, they are frequently brought on by volcanic eruptions intense rains or seismic activity. These catastrophes have the potential to bury communities seriously harm infrastructure and interfere with transportation networks. Another serious risk is earthquakes which occur when energy in the Earth's crust is suddenly released and causes severe shaking. Structural collapses tsunamis and fatalities may result from them and they may happen suddenly [2][3].

Massive ocean waves known as tsunamis are caused by seismic activity that occurs underwater such as earthquakes or volcanic eruptions. Increasing in height as they approach land and submerge coastal areas these waves can travel great distances at a high speed. Given their sudden onset and strong currents that have the potential to cause extensive damage tsunamis present a special threat. On the other hand, floods happen when rivers and lakes overflow due to heavy rains or abrupt releases of water from reservoirs. In addition to harming agricultural land and submerging entire cities flooding can cause long-lasting disruptions in the affected areas [4][5].

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Because of their interdependence earthquakes and floods can both set off secondary disasters like landslides or infrastructure failures. Factors like deforestation urbanization and climate change are contributing to the increasing frequency and severity of these types of disasters which emphasizes the critical need for effective disaster preparedness and management systems [6][7].

II. LITERATURE REVIEW

Table 1: Literature Survey

Sr No.	Title	Year	Objective	Methodologies	Advantages	Future Scope
1.	RescueAid: Smartphone-Aided Situational Awareness [8]	2023	Improve situational awareness in emergencies	Utilized smartphones and ML-based object/event detection tools.	Provides real-time sensory data to responders and command centers.	Integrate with existing emergency response systems and expand sensor capabilities.
2.	Machine Learning for Emergency Management [9]	2023	Survey ML applications in disaster management	Conducted a survey and analysis of existing ML applications.	Highlights potential of ML for real-time response, data analysis, and prediction.	Develop more robust and accurate ML models for specific disaster scenarios.
3.	A Systematic Review of Disaster Management Systems Approaches, Challenges, and Future Directions [10]	2023	Explore various disaster management technologies and challenges	Comprehensive review of big data, cloud computing, IoT, GIS, and ML.	Highlights need for a holistic approach combining multiple technologies for improved effectiveness.	Emphasize technology integration, system resilience, community engagement, and ethical considerations in future research.
4.	WATERSensing: A Smart Warning System for Natural Disasters in Spain [11]	2021	Design a social sensing application for preventing and evaluating water-related disasters	Data collection from social media platforms (Twitter, Telegram), NLP processing for topic categorization, and visualization with geolocation.	Real-time detection, crowd-sourced data utilization, and cost-effectiveness.	Expansion to other disasters, multi-language support, and integration with additional social media platforms like YouTube and Instagram.
5.	An Energy-efficient Modified Metaheuristic Inspired Algorithm for	2021	Improve energy efficiency in disaster management	Utilized a metaheuristic algorithm for optimizing resource	Contributes to operational efficiency by minimizing energy	Explore application of the algorithm in diverse WSN-based disaster

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	Disaster Management System Using WSNs [12]		systems using WSNs	allocation and energy use.	consumption during disasters.	management scenarios.
6.	Machine Learning on Satellite Radar Images to Estimate Damages After Natural Disasters [13]	2020	Develop a machine learning approach using satellite radar images to classify building damage status after wildfires.	Data collection from Sentinel-1 A/B satellites, feature engineering, modelling with various ML models, and validation with 5-fold cross-validation.	High resolution of SAR data, efficient and scalable damage assessment across large areas.	Broader applications to other disasters like floods and hurricanes, incorporating real-time data, and improving model accuracy with additional data sources.
7.	Disaster and Pandemic Management Using Machine Learning: A Survey [14]	2020	Review state-of-the-art ML algorithms for disaster and pandemic management.	Detailed literature review on ML algorithms and their integration with technologies like IoT, UAVs, and satellite systems.	Enhanced accuracy in predicting disasters and pandemics, better resource utilization, and reduced human intervention through automation.	Integration with 5G and blockchain, improving algorithms, and enhancing scalability of ML models.
8.	Effective Disaster Recovery for Edge Computing Against Large-Scale Natural Disasters [15]	2020	Enhance disaster recovery in edge computing systems	Backup TCO selection based on disaster prediction, storage capacity, and network information.	Reduces network hops and mitigates data loss compared to conventional methods.	Optimize backup strategies for various disaster scenarios and integrate with advanced prediction models.
9.	Can We Detect Trends in Natural Disaster Management with telligence? [16]	2020	Review AI applications in disaster management	Systematic review of AI models across various stages of disaster management.	Identifies gaps in accuracy and efficiency, emphasizes the need for generalization.	Develop more accurate and efficient AI models that generalize across diverse disasters.
10.	The SENSE-ME Platform [17]	2017	Infrastructure-less communication and decentralized sensing	Decentralized phone-sensing network, opportunistic networking, mobile sensing, and distributed information processing.	Enables spontaneous data collection in emergencies without fixed infrastructure.	Enhance scalability and robustness of the platform.

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RescueAid is a smartphone-based platform that this study suggests developing for improved emergency response and management. By collecting and analysing IMU data from on-board sensors and camera images RescueAid leverages the capabilities of first responders' smartphones to give incident commanders and response teams situational awareness and real-time decision-support. RescueAid facilitates informed decision-making during emergency incidents by processing and analysing data in real-time. This has the potential to enhance response times minimize damage and ultimately save lives [8].

Emergency managers are using machine learning algorithms more often to support decision-makers and first responders in the planning preparation response and recovery phases of a disaster. These algorithms offer useful tools for use in emergency management applications since they are well-suited to handle the massive volumes of spatiotemporal data generated during emergency situations. In order to provide a consistent operational framework for applying machine learning in emergency management machine learning finds applications across a variety of emergency events and highlights commonalities worth examining. In spite of recent developments more work is required to earn the confidence of emergency management staff and put these algorithms to practical use in order to realize their potential advantages [9].

In order to identify efficient disaster management techniques and technologies this research paper conducts a thorough analysis of numerous studies pertaining to earthquake management systems. High-quality studies that made a substantial contribution to the advancement of knowledge in this field were given priority during a comprehensive literature search that was carried out using academic databases and online libraries. In order to comprehend the state-of-the-art in earthquake management systems at the time the analysis comprised grouping pertinent studies into four categories: keyword output type of earthquake detector and seismic effect. In order to effectively mitigate the effects of earthquakes and other natural disasters the findings emphasize the significance of making investments in robust disaster management systems involving communities in preparedness efforts and addressing issues like resource allocation communication and information dissemination [10].

In the paper WATERSensing: A Smart Warning System for Natural Disasters in Spain a system based on social sensing techniques is presented for the early detection and management of water-related disasters like floods. The system created as part of the WATERoT project uses natural language processing (NLP) techniques to analyse posts about water issues in real-time. It leverages data from social media platforms such as Twitter and Telegram. A case study on Storm Gloria in January 2020 shows how well the system works to link social media activity with real-world disaster events providing information that can be used to enhance emergency response protocols. With the help of the architectures modules for data gathering semantic analysis and visualization authorities can quickly identify possible threats [11].

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For disaster management systems that use Wireless Sensor Networks (WSNs) an energy-efficient modified metaheuristic inspired algorithm called ModifyGA is proposed. This algorithm creates a fitness function that maximizes network lifetime by integrating criteria and dynamic sensing range. By optimizing intra-cluster distance systematically using node energy within the cluster lowering hop-count and encouraging the selection of highly capable nodes for cluster-heads the ModifyGA addresses the problems of cluster overlapping electing lower-energy nodes as cluster-heads highly dense clusters and hot spot issues in the network. The usefulness of ModifyGA with a single static sink several static sinks and movable sinks is demonstrated by simulation analysis highlighting the technology's potential as a cost-effective option for WSN-based disaster management systems [12].

In order to estimate the damages caused by natural disasters like wildfires this research study presents a machine learning-based method that makes use of geographical data and satellite radar images (SAR). By evaluating SAR images and categorizing the state of damage to individual buildings the system generates damage proxy maps. After making the required modifications the model which was trained on historical data can be used to predict the path of different natural disasters such as hurricanes and floods. Through the ability to quickly and accurately assess damages following disaster events this approach has a high potential to improve social resilience by facilitating timely relief efforts and well-informed decision-making [13].

A thorough overview of machine learning (ML) applications in disaster and pandemic management can be found in the research paper Disaster and Pandemic Management Using Machine Learning: A Survey. Modern machine learning algorithms that are utilized to forecast disasters plan evacuation routes for large crowds examine social media posts and support post-disaster scenarios are reviewed. Challenges unresolved issues and future research directions for ML-based disaster and pandemic management are highlighted by the authors as they discuss how various ML models integrated with other technologies such as IoT object sensing 5G networks smartphones and satellites can be deployed at different phases of disaster management [14].

In the context of major natural disasters this paper discusses disaster recovery for edge computing (EC) emphasizing the prevention of data loss and the mitigation of network congestion. Due to the massive volume of data especially from video IoT devices EC faces difficulties like network congestion in contrast to traditional cloud computing (CC) where data is backed up to geographically disparate locations. The suggested approach uses network hops between distributed telephone central offices (TCOs) storage capacity and disaster prediction data to choose TCOs as backup locations. The approach is more effective than conventional methods according to simulations as it lessens network congestion and boosts data backup efficiency while retaining resilience against disaster prediction underestimation [15].

The application of artificial intelligence (AI) models in various stages of natural disaster management (NDM) is systematically reviewed in the research paper titled Can we detect trends in natural disaster

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management with artificial intelligence? A review of modelling practices. The review examines the application of AI techniques such as neural networks support vector machines and fuzzy logic in NDM for disaster preparedness response and recovery drawing on 278 studies. In order to facilitate tasks like risk assessment early warning systems and emergency management it emphasizes how effective AI is at processing complex data. The study highlights patterns knowledge gaps and prospective avenues for future investigation including the necessity of more multidisciplinary methods and improved integration of resilience and climate change factors. All things considered artificial intelligence holds great promise for raising the precision and efficiency of decision-making in the context of disasters [16].

The SENSE-ME platform which is intended for smartphone-based emergency management is introduced in the research paper The SENSE-ME platform: Infrastructure-less smartphone connectivity and decentralized sensing for emergency management. Even in the absence of traditional infrastructure it permits ad hoc network creation and decentralized sensing via smartphones. By employing peer-to-peer communication techniques such as Wi-Fi Direct the platform facilitates the sharing of environmental data and real-time analysis between devices to identify emergencies and direct evacuation procedures. SENSE-ME combines mobile sensing and distributed decision-making algorithms to improve emergency response by utilizing smartphone sensors for tasks like building evacuation. This paper assesses the systems performance in terms of sensing network formation and information dissemination emphasizing how well it works in environments with limited resources [17].

III. MOTIVATION

Although conventional approaches to disaster management have depended on static models and historical data to forecast similar occurrences these methods frequently fail to provide early warnings and real-time updates. More sophisticated solutions that can handle massive volumes of data in real time are required due to the unpredictable nature of natural disasters and the changing environmental conditions surrounding them. A fully integrated solution is still lacking in the field previous research has concentrated on components such as sensor networks predictive modelling or Geographic Information Systems (GIS).

By combining machine learning algorithms and GIS technologies SafeAlert aims to provide a complete disaster management solution in response to this need. SafeAlert employs predictive algorithms to anticipate possible disaster events in addition to monitoring real-time data facilitating more precise and prompt responses. In order to help communities reduce the risk of disaster get ready for impending threats and recover more quickly the platform offers an intuitive interface for real-time visualization alert generation and emergency response coordination.

IV. OBJECTIVES

SafeAlert's main goal is to create a data fusion system in real-time that combines data from various sources like weather APIs, IMD data and Geographic Information Systems (GIS). This platform will offer a thorough situational awareness system, allowing responders and decision-makers to obtain

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immediate insights into disaster events. By incorporating sophisticated machine learning algorithms like Support Vector Machines (SVMs) and Recurrent Neural Networks (RNNs), the system's goal is to accurately forecast disaster events and issue alerts promptly. This ability will enhance readiness and ensure a quick, data-based reacton, improving the efficiency of disaster management initiatives.

Furthermore, SafeAlert aims to create a user-friendly interface that works on multiple platforms like the web and Android. This will make it easy for first responders, government agencies, and community members to access alerts and tools for collaboration. The platform will give importance to interoperability, making sure it can integrate easily with current disaster management systems and encouraging open data-sharing protocols to help different agencies work together in coordinating responses. The project's goal is to simplify communication, enhance decision-making, and encourage collaboration in disaster management through an intuitive and interoperable system.

V. PROPOSED SYSTEM DESIGN

Because natural disasters are unpredictable and environmental conditions are dynamic traditional disaster management approaches primarily rely on historical data and static models which frequently prove inadequate in providing real-time updates and early warnings. While current solutions concentrate on specific elements such as sensor networks or predictive modelling, they do not offer a fully integrated approach capable of processing large amounts of data efficiently in real time and offering comprehensive capabilities for disaster management.

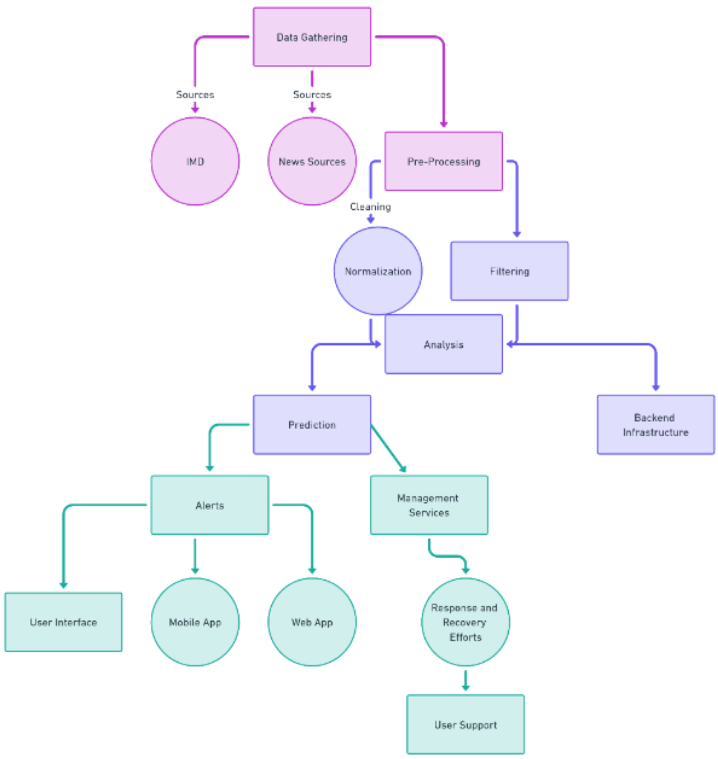

Figure 1: Proposed Block Diagram for SafeAlert

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Volume 3 | Issue 5 | October 2024

Figure 1: The provided block diagram outlines the core components and processes involved in SafeAlert's disaster management system. It illustrates a two-tiered approach, with a data processing and analysis tier on the top and a management services tier on the bottom. Data gathering collects diverse data sources, while preprocessing cleans and prepares the data for analysis. Machine learning algorithms are applied in the analysis tier to extract insights and patterns, which are used to generate predictions and alerts. The management services tier provides tools and functionalities for effective disaster management and coordination. This block diagram effectively represents SafeAlert's core functionalities, demonstrating its ability to collect, process, analyse, and predict potential disasters, while also providing essential management services for effective response and recovery.

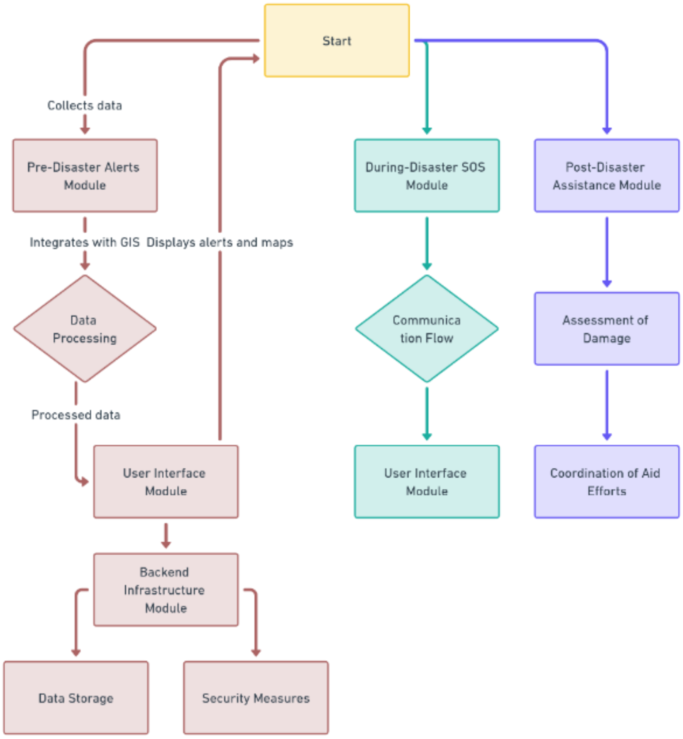

Figure 2: Proposed System Architecture for SafeAlert

Figure 2: The essential elements and procedures of SafeAlert's disaster management platform are depicted in the system architecture diagram that is provided. The frontend includes a mobile app and website with real-time alerts and information about disasters. For secure data storage and scalable data processing the backend is dependent on AWS cloud infrastructure. Users receive alerts and notifications as well as analysis and prediction from machine learning algorithms. During calamities the platform provides real-time safety guidelines post-disaster charity management and pre-disaster preparedness features. Furthermore, SOS services and emergency responder access are combined to guarantee efficient reaction and recuperation. This architecture exemplifies how SafeAlert can offer complete disaster management capabilities by utilizing machine learning cloud computing and intuitive user interfaces.

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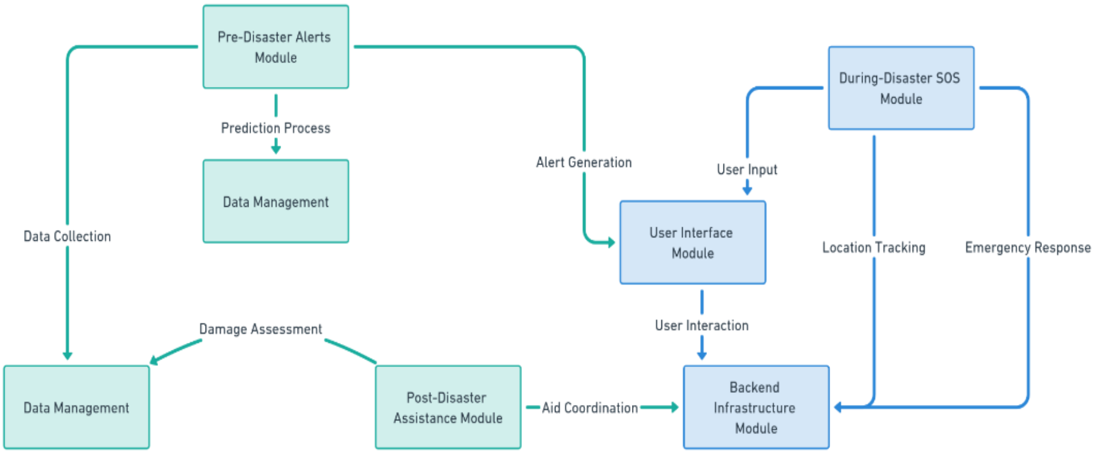

Figure 3: Proposed Flow Chart for SafeAlert

Figure 3: The essential procedures of SafeAlert's disaster management system are delineated in the provided flowchart. User interaction is the first step and then data collection and risk assessment. The system processes data generates alerts handles emergency response and provides post-disaster support if a risk is detected. The system ends if there is no risk found. The decisions made by SafeAlert and the sequential actions required for disaster management are well-represented by this flowchart.

VI. RESULT AND CONCLUSION

A major increase in the precision and promptness of natural disaster forecasts resulting in more potent early warnings is one of the SafeAlert projects anticipated outcomes. SafeAlert aims to provide real-time environmental data analysis by integrating machine learning algorithms and GIS technologies which will help communities and authorities prepare for disasters more precisely. The system's capacity to produce alerts and visualizations within an easy-to-use interface will improve emergency response teams' coordination speeding up response times and limiting damage. In addition, communities should feel more empowered with SafeAlert as it provides easily accessible resources to track disaster risks and make educated decisions. Through a thorough and integrated approach to disaster management the platform seeks to enhance disaster resilience reduce the number of fatalities and protect infrastructure.

To sum up the SafeAlert project combines cutting-edge technologies like machine learning and GIS for real-time data analysis prediction and response coordination thereby presenting a revolutionary approach to disaster management. It solves the shortcomings of conventional disaster warning systems and offers a more proactive way to lessen the effects of natural disasters by offering a fully integrated platform that improves situational awareness. Communities in disaster-prone areas may become more resilient infrastructure damage may be minimized and lives could be saved with SafeAlert. Platforms like SafeAlert will become more and more important in anticipating responding to and recovering from natural disasters as technology develops eventually helping to create societies that are safer and more sustainable.

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VII. LIMITATIONS

The SafeAlert project shows potential but is restricted by various limitations that may affect its success. A significant issue is the adequacy and precision of live data, as the system relies on communication networks to anticipate disasters and locate survivors. Limited infrastructure or disrupted connectivity in certain areas can impede the accuracy of warnings and the efficiency of tracking survivors due to inconsistent data. Additionally, the project's use of machine learning in disaster prediction brings the possibility of false positives, which could result in unwarranted evacuations or create public anxiety. Maintaining high prediction accuracy while reducing false alarms will be a crucial obstacle in establishing trust and ensuring prompt reactions.

Another constraint is the high resource requirements when implementing cutting-edge technologies such as edge computing, GIS, and machine learning. In some regions, especially in developing countries or disaster-prone rural areas, there may be a lack of sufficient computational power, energy, and expertise needed for these technologies. Moreover, privacy and ethical issues emerge when monitoring survivor whereabouts and gathering personal information in disaster relief efforts. It will be crucial to gain public trust by ensuring the safety of this sensitive data and following data protection regulations. Ultimately, the implementation of the platform could encounter opposition because of limited digital knowledge or insufficient education for emergency personnel and the public. Conquering these restrictions is essential for the project to achieve long-term success and scalability.

REFERENCES

[1] National Geographic, "Natural Disasters," National Geographic, https://www.nationalgeographic.com/environment/natural-disasters.

[2] Geological Survey of India (GSI), https://www.gsi.gov.in/webcenter/portal/ Landslides

[3] National Centre for Seismology (NCS), "Earthquake Monitoring and Reports," NCS.gov.in, [Online]. Available: https://seismo.gov.in/.

[4] National Disaster Management Authority (NDMA), "Tsunami - Preparedness and Response," NDMA.gov.in, [Online]. Available: https://ndma.gov.in/en/tsunami.html

[5] National Disaster Management Authority (NDMA), "Flood Management," NDMA.gov.in, [Online]. Available: https://ndma.gov.in/en/floods.html

[6] Ministry of Environment, Forest and Climate Change (MoEFCC), "Climate Change in India: A 2020 Perspective," MoEFCC.gov.in, [Online]. Available: http://moef.gov.in/

[7] National Institute of Disaster Management (NIDM), "Urbanization and Disaster Risk Reduction," NIDM.gov.in, [Online]. Available: https://nidm.gov.in/

[8] C. Laoudias, P. Kolios, and G. Ellinas, "RescueAid: Smartphone-Aided Situational Awareness for Emergency Response," in 2023 24th IEEE International Conference on Mobile Data Management (MDM), Singapore, Singapore, 2023, pp. 192-195. doi: 10.1109/MDM58254.2023.00040.

[9] C. Kyrkou, P. Kolios, T. Theocharides, and M. Polycarpou, "Machine Learning for Emergency Management: A Survey and Future Outlook," Proceedings of the IEEE, vol. 111, no. 1, pp. 19-41, Jan. 2023. doi: 10.1109/JPROC.2022.3223186.

[10] S. M. Khan, I. Shafi, W. H. Butt, I. de la Torre Diez, M. A. L. Flores, J. C. Galán, and I. Ashraf, "A Systematic Review of Disaster Management Systems: Approaches, Challenges, and Future Directions," Land, vol. 12, p. 1514, 2023. doi: 10.3390/land12081514.

[11] J. M. Cecilia et al., "WATERSensing: A Smart Warning System for Natural Disasters in Spain," IEEE Consumer Electronics Magazine, vol. 10, no. 6, pp. 89-96, Nov. 2021. doi: 10.1109/MCE.2021.3063703.

[12] S. Singh, A. S. Nandan, A. Malik, N. Kumar, and A. Barnawi, "An Energy-Efficient Modified Metaheuristic Inspired Algorithm for Disaster Management System Using WSNs," IEEE Sensors Journal, vol. 21, no. 13, pp. 15398-15408, Jul. 2021. doi: 10.1109/JSEN.2021.3074497.

[13] B. Xie, J. Xu, J. Jungkyo, S. H. Yun, E. Zeng, E. M. Brooks, M. Dolk, and L. Narasimhalu, "Machine Learning on Satellite Radar Images to Estimate Damages After Natural Disasters," in Proceedings of the 28th International Conference on Advances in Geographic Information Systems (SIGSPATIAL '20), Association for Computing Machinery, New York, NY, USA, 2020, pp. 461–464. doi: 10.1145/3397536.3422349.

[14] V. Chamola, V. Hassija, S. Gupta, A. Goyal, M. Guizani, and B. Sikdar, "Disaster and Pandemic Management Using Machine Learning: A Survey," IEEE Internet of Things Journal, vol. 8, no. 21, pp. 16047-16071, Nov. 2021. doi: 10.1109/JIOT.2020.3044966.

[15] T. Tsubaki, R. Ishibashi, T. Kuwahara, and Y. Okazaki, "Effective Disaster Recovery for Edge Computing Against Large-Scale Natural Disasters," in 2020 IEEE 17th Annual Consumer Communications & Networking Conference (CCNC), 2020. doi: 10.1109/CCNC46108.2020.9045528.

[16] L. Tan, J. Guo, S. Mohanarajah, et al., "Can We Detect Trends in Natural Disaster Management With Artificial Intelligence? A Review of Modeling Practices," Natural Hazards, vol. 107, pp. 2389–2417, 2021. doi: 10.1007/s11069-020-04429-3.

[17] G. Aloi, O. Briante, M. Di Felice, G. Ruggeri, and S. Savazzi, "The SENSE-ME Platform: Infrastructure-less Smartphone Connectivity and Decentralized Sensing for Emergency Management," Pervasive and Mobile Computing, vol. 42, pp. 187-208, 2017. doi: 10.1016/j.pmcj.2017.10.004..

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