

The Synergy of Artificial Intelligence (AI) and Geographic Information Systems (GIS) for Enhanced Disaster Management: Opportunities and Challenges

Letter to the Editor

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Keywords:



artificial intelligence; disaster; geographic information systems

Abbreviations:

AI, Artificial Intelligence; GIS, Geographic Information Systems; ML, Machine Learning

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Natural calamities are perilous occurrences stemming from the earth's natural phenomena. Floods, earthquakes, hurricanes/cyclones, volcanic eruptions, tsunamis, among other geological events, are examples of such disasters. Disasters instigated by human action or anthropogenic disasters result from human endeavors. These disasters negatively impact human beings, other life forms, and, ultimately, entire ecosystems. Instances of anthropogenic disasters encompass various forms of pollution, nuclear and chemical catastrophes, biological disasters, terrorist strikes, and other unintentional mishaps.¹ Disaster reduction necessitates the consolidation of data from various origins. Geographic information system (GIS) is a powerful tool that enables us to capture, store, manipulate, analyze, and visualize spatial data. It has proven invaluable in mapping and understanding geographic information, including topography, land use, infrastructure, and population distribution. At the heart of GIS lies a collection of maps that are assigned spatial references and stored as points, lines, polygons, or raster data. GIS simplifies the process of attributing characteristics to these spatial entities and merging disparate information layers.²

The integration of artificial intelligence (AI) into GIS has the potential to revolutionize disasters, analyze and respond, improving efficiency and saving lives. With the inclusion of AI, GIS can become even more robust and efficient in handling large-scale data analysis and decision-making in disaster management scenarios. AI algorithms can enhance GIS capabilities by automating data processing, pattern recognition, and predictive modeling. Machine learning (ML) algorithms can be trained to analyze historical disaster data and identify patterns that enable the prediction of future disasters and their impacts. This predictive ability is crucial for proactive disaster preparedness and resource allocation.^{3,4}

Furthermore, AI can support real-time monitoring and early warning systems. By analyzing sensor data, satellite imagery, social media feeds, and other relevant sources, AI algorithms can quickly detect anomalies, identify potential disaster events, and provide timely alerts.⁵ This early warning can significantly improve response times and emergency preparedness. During a disaster, AI-powered GIS can assist in disaster response and recovery efforts. AI algorithms can analyze data sets in real time, enabling responders to identify critical areas of concern, such as damaged infrastructure, population density, and resource distribution. This information facilitates efficient resource allocation and coordinated rescue operations. Additionally, AI can aid in damage assessment. By combining pre-disaster GIS data with post-disaster imagery, AI algorithms can automatically analyze the extent and severity of damage to buildings, roads, and other infrastructure, assisting authorities in prioritizing recovery and reconstruction efforts.³

However, it is important to mention that the application of AI in GIS and disaster management also brings forth certain challenges. These include ensuring data accuracy and quality, addressing ethical considerations, and addressing potential biases in algorithmic decision-making. It is crucial to involve domain experts, policy-makers, and stakeholders in the development and deployment of AI in these contexts to mitigate risks and ensure responsible use. In conclusion, the synergy between AI and GIS holds immense potential for revolutionizing disaster management practices. By leveraging the power of AI algorithms, we can enhance GIS capabilities for predictive analysis, early warning systems, response coordination, and damage assessment.

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