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Use of Artificial Intelligence (AI) For Disaster Prediction and Risk Reduction

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ABSTRACT: ***Natural disasters have the ability to cause massive devastation and economic loss. Actual harm and loss have been escalating in recent decades. As a result, disaster managers must assume a greater duty to safeguard their populations proactively by adopting effective management plans. Several research papers use artificial intelligence (AI) tools to handle disaster data in order to aid in disaster management. Artificial intelligence can plan for disasters in a way that a human mind would find difficult to achieve under pressure. This includes improved crowd management skills, the capacity to organised rescue operations, and the capability to overcome prejudices relating to race, religion, gender, caste, disability, and age. In this paper, the author reviewed the use of AI in management of natural disaster and Disaster risk Reduction which can future researchers to explore more and more for better economy of the nation.***

KEYWORDS: ***Artificial Intelligence (AI), Disaster Management, Earthquake, Natural Disaster, Weather.***

1. INTRODUCTION

Natural disasters are becoming more frequent and severe, reflecting the immediate consequences of climate change and driving a rising cycle of humanitarian crises. Fortunately, modern technology can assist in detecting and preparing for weather extremes and other disasters, as well as efficiently communicating the essential response to individuals and communities. Natural disaster surveillance, forecasting, and management approaches have advanced significantly during the last century as a result of technology advancement. These new technologies include the application of artificial intelligence, which, because of its capacity to predict future occurrences, has the potential to make a significant impact in reducing the material and human costs of these kind of disasters[1].

Natural disasters are happening more often across the earth as a result of climate change. Earthquakes, tsunamis, floods, and volcanic eruptions are particularly devastating and deadly [2], [3]. Therefore, there is a need for technology that can foresee these catastrophes, giving people enough time to prepare for evacuation and protecting both lives and property. Projects are being funded and researched by organisations ranging from government agencies, businesses, and universities with an emphasis on employing artificial intelligence (AI) as a predictive tool to anticipate and estimate the consequences. Additionally, the technology has the ability to help relief efforts in an efficient manner, hence reducing deaths. Major endeavors, however, are still at the level of scholarly research, and it may take a few years before the efforts are successful [4]. The four stages of disaster management are mitigation, preparedness, response, and recovery, as indicated in Figure 1. The mitigation phase is when management efforts are made to avoid or lessen potential crises and their effects in the future with long-term benefits.

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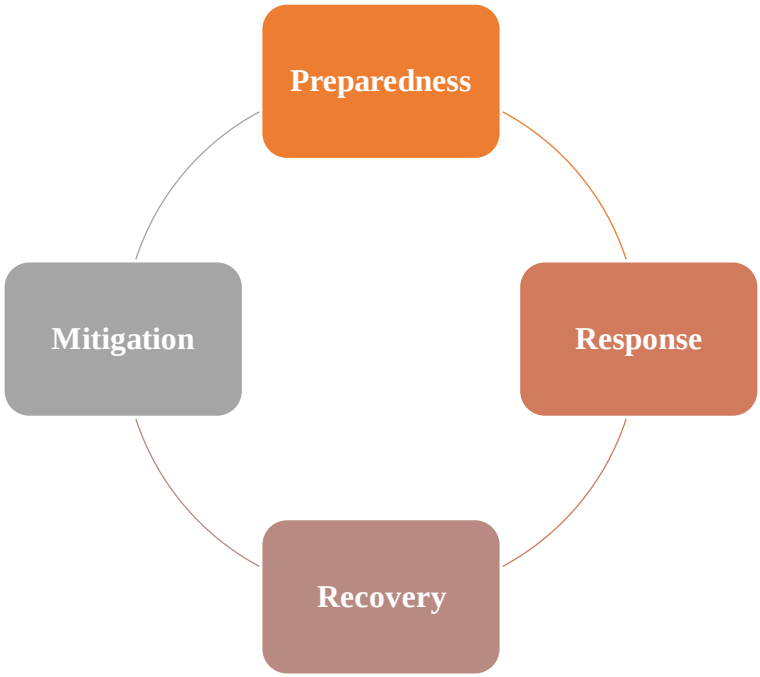

Figure 1: Illustrating the four phases of Disaster Management.

1.1. AI For prediction of Earthquakes

Artificial intelligence is proven to be a useful tool for identifying and analysing the early symptoms of these sorts of disasters because seismic forecasting mostly includes predicting the likelihood of unexpected and catastrophic earthquakes. High-magnitude earthquakes, which seismologists would most want to be able to forecast, but also the rarest because of the extraordinary nature of the circumstances necessary for them to occur. This presents a significant challenge for researchers from time to time. This brings up the issue of the algorithm's inability to be adequately trained due to a shortage of data. On the other hand, daily little, unnoticeable earthquakes happen along the same fault lines that give rise to high-intensity occurrences, and they also follow the same physics and mechanics. In the search to understand and forecast earthquakes, these "micro-earthquakes" constitute a valuable source of untapped knowledge[5][6].

A group of Stanford University academics created a novel machine learning method called Earthquake Transformer with the explicit goal of addressing this challenge. This algorithm is capable of offering a degree of accuracy comparable to human assessments as well as identifying a greater number of earthquakes, especially low earthquakes that are typically missed by existing detection methods. This improved detection capability was obtained by modifying the best medical image processing and audio capture algorithms to identify even the tiniest signals. The ability to locate and analyse the tiniest earthquakes is of great importance because it improves the understanding of how these occurrences are spread along fault lines and teaches us more about how they start and finish.

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1.2. AI in Predicting Cyclones and Hurricanes

The numerous factors at play, such as shifting wind patterns, tides, ocean currents, etc., make it difficult to predict natural calamities. For the handling of natural disasters, prescriptive modeling may be a priceless resource. They can automatically integrate fresh data, improve physical models, and produce findings with great resolution.

For meteorological occurrences like tropical cyclones, hurricanes, and winter storms, modern disaster management teams have created high-resolution forecast models. These simulations can produce accurate representations of these phenomena' structures, worldwide distribution, and seasonal variations[7]–[9].

1.3. Facilitation of Decision Making Process Amid Natural Disaster

It is challenging to anticipate which locations may experience flooding due to uneven terrain, precipitation, thaws, or rising water levels, among other factors. Scientists and business titans from Silicon Valley intend to utilise artificial intelligence technologies that are fed data from satellite photos in addition to that supplied by maps in order to account for the enormous range of criteria that must be taken into consideration. For instance, Google researchers built a computer model of the landscape in India, where there are often periods of severe rainfall, using hundreds of satellite photographs. They then produced multiple simulations using this model to determine how the rivers may act during a flood [10].

On the basis of this, Google Research engineers have created an artificial intelligence programme that can forecast weather conditions to the nearest five minutes. While this "ML for Precipitation Nowcasting from Radar Images" technology is perfectly adapted to weather forecasting, it may also hold the secret to foreseeing certain future natural disasters. In more literal words, Google researchers have chosen to ignore the rules of physics and use image recognition algorithms to process satellite images like pictures. The programme attempts to recreate the pictures on its own after retrieving them in their highest possible definition and compressing them. The tech business has taught its AI to make educated guesses about how each cloud and weather event functions by supplying it with weather photos captured between 2017 and 2019.

2. DISCUSSION

How can we guarantee that an AI-based algorithm will be used to help natural disaster mitigation after it has been demonstrated to properly identify (as in the case of the avalanche example) or forecast (as in the case of the flood example) natural disasters? We must first solve the gap between those creating the AI-based algorithms and those who will use them.

There are challenges that persist in using AI in disaster prediction and management that can come at any stage. In addition to that, it is crucial to take into account the following while collecting and processing data: (a) biases in training and testing data; (b) new distributed AI techniques inside the data domain; and (c) ethical concerns. It is crucial to check that data are accurately collected and that each pattern is adequately represented for the given problem in order to avoid biases in training and testing datasets. Think about the difficulty of creating a dataset with instances of severe occurrences, for instance (which are, by nature, rare). Consider the potential consequences of not providing adequate data as well, such as inaccurate projections or biased results.

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The output of an AI model must be comprehensible and acceptable to humans after it has been created. This can be difficult to achieve since there isn't a standard out-of-the-box human-machine interface that explains the reasoning behind the AI model's judgments. As a result, numerous academics are attempting to create reliable AI solutions. A detailed articulation of the issue, as well as the needs and expectations of the AI-based solution, is crucial during modelling and model assessment, for example. Then and only then can the problem-solving model and learning method be built. Furthermore, selecting and creating appropriate assessment criteria is aided by being aware of the particular arrangement.

It is crucial to take into account the above data and model development-related problems as well as user communication challenges for an AI-based model that is regarded suitable for practical implementation. Utilizing AI-based communication tools, these are investigated. It is necessary to translate and show AI model outputs in accordance with end-user requirements in order to enhance and easier interpretation. The development and evaluation of warning and initial alert system, decision support tools, projections, dashboards, Chatbot, hazard and risk maps, and other AI-enhanced communications tools must therefore involve all relevant stakeholders, from local communities to case of emergencies system managers and NGO disaster response leaders. Disaster responders must promptly provide input on and evaluate AI model findings in order to raise the accuracy and quality of such insights. To build trust and improve machine learning-based suggestions, it is crucial to be transparent about the data sources that are absorbed, the frequency of information refresh, and the communication tools' algorithms. An AI-enhanced system's levels of confidence, ambiguities, and restrictions must be communicated in a comprehensible manner, much like with conventional modelling techniques, to allow for well-informed decision-making. The main obstacle to be overcome is trust in timely and completely transparent AI-based communication solutions. To address the demands of all stakeholders, this calls for effective cooperation among seasoned disaster responders, NGOs, geoscientists, government agencies, telecom firms, regulators, and others. Every sort of disaster is distinct, and each location has varying levels of vulnerability and resilience.

3. CONCLUSION

Exploring the advantages of utilising AI to support current approaches and strategies has garnered a lot of interest in the field of Disaster reduction. The use examples presented in this article revealed how AI-based models are improving disaster risk reduction, but they also illustrated the difficulties that AI faces. Thankfully, the promise of AI in Disaster reduction has spurred research to address these issues and inspired new collaborations, bringing together specialists from various agencies, from different scientific fields, from various sectors, and from all over the world. In particular, we think that more work has to be done to provide educational resources that will assist capacity building and ensure the potential use of AI in Disaster management and risk reduction. The application of artificial intelligence to the forecasting of natural disasters, along with the development of new technologies, unquestionably opens up a wide range of opportunities for assisting governments in their ability to comprehend and perception of natural phenomena, even though there is still a long way to go. They are now able to track the development of these occurrences with more accuracy due to the use of these intelligent technologies, allowing them to respond correctly and lessen the effects on people and the environment.

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