

Chapter 10

Machine Learning Algorithms for Natural Disaster Management

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ABSTRACT

The repercussions of natural disasters can be devastating to the local population, and their recurrence is unavoidable. Scientists all throughout the globe are trying to figure out how to reliably predict when these disasters will strike. In order to create early warning systems that can notify communities and individuals in impacted areas, enabling them to take appropriate measures and lessen the disaster's impact, it is required to analyze a variety of environmental, geological, and meteorological elements. When it comes to disaster management, ML algorithms are great for handling big amounts of data that are naturally formed in surroundings and can handle multiple dimensions. A number of disaster management activities, including predicting when and where crowds will evacuate, evaluating social media posts, and managing sustainable development, have found applications for these algorithms. This chapter provides a comprehensive overview of the several machine learning (ML) and deep learning (DL) methods that have been used for managing and predicting natural disasters.

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1. INTRODUCTION

Natural disasters occurrence is inevitable and its consequences can impact the inhabitants of that area harshly. Researchers throughout the world are concerned about discovering ways which can give accurate warnings about the occurrence of these disasters. It involves the analysis of a range of environmental, geological, and meteorological factors to develop early warning systems that can alert people and communities in affected areas, allowing them to take necessary precautions and minimize the impact of the disaster. We come across natural disaster at regular intervals so we are trying to predict them using Machine Learning. Various technologies such as IoT, object sensing, 5G and cellular networks, smartphone-based systems, and satellite-based systems are being applied actively these days for gathering the data about natural disaster occurrence and the details of the regions where and when they happen. Machine Learning (ML) has speeded up the potential of understanding the patterns of occurrence and the factors that lead to natural hazards effectively. ML algorithms can handle multi-dimensional, large volumes of data related to disaster management that is created naturally in environments and are particularly applicable for related key tasks such as classification and recognition. Applications of these algorithms are found to be useful in the prediction of disasters and in assisting the disaster management tasks such as determining crowd evacuation routes, analysing social media posts, and handling sustainable development. This chapter reviews various ML/Deep Learning (DL) algorithms that have been applied for the prediction of natural disasters and their management. Insight to the performance of state of art approaches like Convolutional Neural Networks, time-distributed Long-Short Term Memory (LSTM) cells is also provided. Finally, this chapter presents some hybrid approaches which can be explored and expected future trends of applications of ML and DL in natural disasters.

1.1 ML and DL Methods for Natural Disaster Management

The systems developed for assisting with disaster prediction need to be robust enough to handle the challenges that can affect a disaster management system (Du X et al., 2007). For instance, in case of a sandstorm or a hurricane, the vision of a system can be lowered due to the presence of dust particles, or, in hazy conditions, autonomous driving system should be safe (Mehra A et al., 2020). Another challenge could be the loss of communication during a disaster. Furthermore, other challenging tasks include maximizing the number of people protected during a disaster or a pandemic, evacuating people at the right time, identifying the vulnerable areas for the spread of a pandemic, reaching the most affected people/areas and providing them with

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