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Review of Disaster Defect Management in Machine Learning

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Abstract - **Internet data performs a crucial part in calamity response during disaster events. The disaster might be natural or man-made, Internet community have proven to be the most productive transmission and combine among afflicted communities. Research has manifested utilizing methods for machine learning to recognize the applicable posts on web, net and other sources for disaster reciprocation. Communication breakdowns and association failures are common issues during disaster response, leading to delayed or inefficient aid distribution. In this paper, we are going to evaluate the effect caused due to calamities. This research is categorized into two proportions: Response after the disaster, identifying the damage caused, and allowing for faster response. The findings of this study may help experimenters in the future identify relevant areas for disaster assessment.**
Keywords: **Disaster Management, Machine Learning, Internet Data**

I. INTRODUCTION

Every year, millions of individuals worldwide confront the far-reaching consequences of natural and man-made disasters, resulting in profound implications for their lives. Tragically, these events often lead to the loss of human lives, alongside substantial damage to infrastructure and properties. The orchestration of handling disasters operations becomes crucial in the phases preceding, during, and following such calamities, with the overarching objectives of averting human casualties, safeguarding both individuals and infrastructure, mitigating economic repercussions, and restoring a sense of normalcy. The intricate nature of disasters, coupled with the critical and intricate aspects response to disasters efforts, necessitate resilient decision-making processes, further fortified by the integration of information technology. The imperative for effective and well-informed disaster management has become increasingly evident, given the scale and repercussions of such events.

In recent times, notable strides in machine learning (ML) have been instrumental in enhancing the capabilities of disaster management. Various types of disasters, ranging from hurricanes, earthquakes, floods, and wildfires, to landslides, necessitate adept management strategies. Furthermore, the application of advanced technologies, particularly in the realm of AI, has proven beneficial in addressing the complexity and scale of these challenges. In the last ten years, a great deal of focus has been placed on the use of web platforms as vital channels for providing updates in real time during emergencies. These updates encapsulate diverse information, spanning from details on fatalities and The accessibility of resources to the pressing requirements of affected and injured individuals.

Following a disaster witnesses a surge in user-generated content on internet community, contributing valuable insights into the prevailing situation, In essence, forums and Internet data not only serve as dynamic repositories of real-time information both during and following emergencies but also as conduits for the global outpouring of emotional responses and support from individuals across the digital landscape. During natural and human-made calamities, a substantial influx of content floods microblogging services, encompassing a variety of data formats such as audio, photos, text, and videos.

Notably, platforms like Twitter have emerged as prominent channels for the exchange of news and updates. Twitter, recognized as a pivotal microblogging site during crises, facilitates the transmission of copious information through tweets. Whether informative or not, chirps in the midst of emergencies consistently feature disaster-related terminology. During periods of crisis, valuable tweets contribute specifics crucial for victims, humanitarian groups, and responders, covering aspects such as the needs of affected individuals, casualties, infrastructure damage, and resource availability.

Twitter's unique feature, allowing users to follow others without mutual consent, extends its utility to non-registered individuals, enabling them to access updates. This inclusive approach empowers community members to monitor critical data in real-time, distinguishing Twitter as an unparalleled platform that aggregates and maintains a substantial repository of potentially life-saving disaster-related information.

In contrast, non-informative tweets lack substantive details about the disaster, making the identification of pertinent information during a catastrophe a challenging task. This study delves into the categorization of damage assessment

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tweets, addressing both human and infrastructure damage, as a binary and multi-class classification challenge. Recognizing the significance of diverse categorical damage information in disaster scenarios, we introduce an innovative approach. This approach involves the development of weighted features through the application of linear regression and SVR techniques for both binary and multi-class classification.

These features incorporate low-level lexical and syntactic attributes, along with the inclusion of the most frequently used words. The experimentation phase involves testing various classifiers to determine the most suitable one for the proposed features. The chosen classifier is then applied to different disaster datasets, and its performance is evaluated using diverse parameters. The key contributions of this study can be outlined as follows.

1. We present a groundbreaking method that leverages low-level lexical and syntactic features, along with the incorporation of top-frequency words weighted using SVR and linear regression algorithms. Notably, our proposed method is vocabulary-independent, ensuring accurate tweet identification even when the training data for the model comes from distinct disaster datasets.
2. A comparative analysis is conducted with various state-of-the-art methods across different datasets. It excels in identifying damage assessment during disasters, showcasing superior performance in both binary and multi-class classification scenarios for both in-domain and cross-domain contexts.

II. PROBLEM DEFINITION

The proliferation of disasters has been increasing day by day, there exists a necessity to manage the effects caused since the calamities that occur. Natural disasters pose significant threats to communities and infrastructure, often resulting in widespread devastation and the need for prompt and effective response strategies. In the realm of disaster management, the identification and rectification of defects in existing disaster response systems are critical for minimizing casualties and mitigating long-term impacts.The existing body of knowledge largely focuses on general disaster preparedness, response, and recovery, but lacks a systematic examination of the defects and shortcomings within these frameworks. This research seeks to address this gap by conducting a thorough analysis of current practices in disaster defect management, encompassing the identification, analysis, and remediation of shortcomings when responding to disasters systems.

III. METHODOLOGY

In disaster defect management, Convolutional Neural Networks (CNNs) are often employed for image analysis and damage assessment. CNNs are particularly effective at capturing spatial hierarchies and patterns within visual data, making them well-suited for duties like identifying structural defects or damages in the following a disaster. Gather relevant image or video data related to the disaster-affected areas. This can include footage, or photographs of internet data before, as well as following the disaster. Preprocess the data by resizing images, normalizing pixel values, and augmenting the dataset to enhance the model's ability to generalize. Divide the dataset into sets for validation and training.

The model is trained to identify patterns and characteristics linked to flaws or damage using the training set. In order to reduce the discrepancy between expected and actual results, the CNN learns to modify its internal parameters (weights and biases) during training. Train the CNN to detect defects or damage in images. The network learns to identify visual patterns indicative of structural issues, such as cracks, deformations, or other visible damage.

The CNN could be fine-tuned to classify the severity of defects or to locate specific types of damage within images. Combine the CNN with Geographic Information System (GIS) data to enhance spatial analysis. This integration allows for mapping the detected defects onto geographical locations and assessing the overall influence on the affected area.

Deploy the trained CNN for real-time monitoring of disaster-affected regions. After the disaster, use the CNN to analyze historical data alongside new data to evaluate the evolution of defects over time. t's crucial to remember that careful assessment of the quality of data is necessary for successful deployment. A Siamese Network is a neural network that consists of two identical subnetworks meaning that they contain the same parameters and weights. Each subnetwork can be any neural network designed for images like a Convolutional Neural Network. Two figures that are either comparable (positive example) or not similar (negative example) are fed into the network.

During training, we pass the images through the subnetworks, and we get as output two feature vectors, one for each image. We want these two vectors to be as close to each other as feasible if the input pairs are similar, and the other way around. To achieve this, we use the contrastive loss function that takes a pair of vectors (x_i, x_j) and minimizes their Euclidean distance when they come from similar images while maximizing the distance otherwise:

$$L = (1 - y) * ||x_i - x_j||^2 + y * \max(0, m - ||x_i - x_j||^2)$$

where y=0 if the images are similar and y=1 otherwise. Also, m is a hyperparameter, defining the lower bound distance between images that are not similar.

Fig. 1 Temple at Chennai before the cyclone effect

Fig. 2 Temple at Chennai after the cyclone effect

K-means clustering is another considerable algorithm in machine learning for disaster defect management. Define the features that are pertinent to the analysis. These could be structural attributes, geographical coordinates, or other measurable characteristics related to potential defects or damage. Standardize or normalize the characteristics to guarantee that they are on a similar scale. This is important for the K-Means algorithm, as it is distance-based. Decide on the number of clusters (K) that the algorithm should identify. This could be based on the features of the data or domain knowledge. Sorting data points into K clusters according to similarity is the aim. Run the K-Means algorithm on the preprocessed data. The closest cluster center, or centroid, is iteratively assigned data points by the algorithm, which then updates the centroids according to the average of the assigned points. The result is K clusters, and Every cluster denotes a collection of related data points.Use geographical information to map the identified clusters onto the affected area. This can provide insights into the spatial distribution of potential defects or areas at higher risk. Combine the results from K-Means clustering with other relevant data sources, such as historical data on disasters, socio-economic data, or real-time sensor data, to enrich the analysis and provide a more comprehensive understanding.

The probabilistic machine learning algorithm Naive Bayes is primarily employed for classification tasks. While it may not be the most typical choice for disaster defect management since it is simplifying assumptions, it can still be applied in certain contexts. Determine which features are pertinent to the process of classification. These could include geographical data, structural features, or other quantifiable qualities. Divide the dataset into sets for testing and training. The training set is utilized to teach the Naive Bayes model to understand the probabilistic relationships between features and classes (e.g., defective or non-defective). Naive Bayes provides probability estimates for each class. This can be useful in disaster defect management for understanding the confidence degree of the model's predictions. Probability estimates can inform decision-makers about the uncertainty associated with classifying certain structures or areas. Depending on The accessibility of new data, the Naive Bayes model can be updated to adapt to changing conditions. Continuous learning allows the model to improve its accuracy over time.

IV. RESULTS AND DISCUSSION

The effect of natural calamities has been atrocious, these natural calamities are among the reasons for migration and mitigation of lives. Several experiments were conducted to understand the underlined reason for cause of natural disasters. Those experiments are the reason to some extent that today we can prevent calamities and also could be retained from those effects. Algorithms are used, as the article mentions, to predict the damage a disaster will cause and to facilitate a quicker response. The study indicates that the negative effects of disasters are getting worse every year. In the previous 12 months, more than 2.5 million humans have been replaced due to natural disasters. Not just human replacement, there exists a loss occurring to infrastructure and properties also.Fig.1. depicts the temple, before the effect of natural disasters. Similarly, Fig.2. depicts the temple, after the effect of natural disasters with the Siamese network algorithm comparison between the two figures is done, which results positive if both the images match else results negative if any mismatch with regards to pixels or the sight of the figures. Data from the internet community has proven to be a valuable resource for disaster management. defects and this article is mainly based on how effectively Internet data is assessed in disaster management. This Internet data can be acquired utilizing the Application Programming Interface(API). The other findings concerning disaster management suggest that inward a gap in completely achieving 100% accuracy within the framework of disaster control. This study also helps to understand how effectively internet data could be used which saves time than assessing the scenes from the catastrophe by physically presenting at the moment. In this article, we tried to achieve that failure with the aspect of handling the disasters.

V. CONCLUSION

One of the major reasons for the loss of human lives and damage to property and infrastructure is natural disasters. The majority of the effects of natural disasters are being exacerbated by man-made practices like deforestation and industrialization. Millions of families were worse off due to the spike in the demand for factories. Controlling these activities is necessary to lessen the effects of nature. The intricacy of disasters has produced an expanding application of Machine Learning(ML) advances. The taxonomy offers a useful method for categorizing upcoming seismic events to direct the distribution of resources for disaster management according to particular requirements. This paper provides the findings of a review study that looked into the ways machine learning approaches have been applied to different aspects of disaster management to support and enhance those operations. The reality that some disaster studies have been written in languages other than English could be significant to this area of study. When users communicate through platforms, there may be variations in the response dynamics and coordination.. It will only be feasible to conduct additional research on these newest Internet community platforms once data extraction API support is in place. The other reviewed research included a wide range of topics including case studies, applications, early warning systems, and risk and vulnerability assessment. This review paper includes another spread of topics such as damage assessment, faster response post-disaster, and hazard prediction. Future studies should focus on utilizing machine learning to increase the efficiency of disaster recovery operations. Since disaster recovery operations have to be long-lasting, studies should concentrate on applying machine learning to improve mitigation efforts and lower vulnerabilities. Robust and validated ML solutions are necessary since the complexity and criticality of disaster operations. Since disaster operations have an impact on human life, the developed models. For decision-makers and domain experts to understand it, it should also be explicable. Additionally, research ought to concentrate on enhancing data quality creating innovative methods for gathering data, and utilizing crowdsourcing to increase the efficiency of disaster management strategies operations based on ML. The figures in this article depict the differences by comparing the input images and it involves the use of Siamese network algorithm. Internet Data performs a crucial role in locating affected individuals, learning about their current situation, and gathering information about different rescue operations carried out during natural and man-made disasters. Our goal in this dissertation was to evolve a machine-learning method for managing disaster assessment data. The primary drawback with this paper is it provides a restricted number of outcomes. Natural disasters can vary greatly in scale and intensity, ranging from localized events to widespread catastrophes. The sheer magnitude of some disasters can overwhelm local, regional, and even national response capacities. Systems that use machine learning models like CNN, as well as systems that use image processing techniques like edge detection, segmentation, and pixel analysis, are the main tools used to address the problems associated with flood management. The most widely utilized methods for acquiring images are UAV imaging, Remote sensing, and SAR. The methods currently in use from both images The domains of processing and machine learning typically concentrate on both pre-and phases after a disaster. When it comes to identifying Internet images about disasters, images are essential. Nevertheless, a number of the highly rated Internet images featuring photos had nothing to do with emergency services. Future studies could incorporate the taxonomy into a sophisticated system, like a drone designed to collect data by scouting areas affected by Natural disasters. enabling natural disasters to be classified in real time before the usage of rescue and aid supplies.

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