Multi Input Disaster Response

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MGT 665

Solving Problems with Machine Learning

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May 12, 2024

Abstract

In this paper, I propose a novel approach combining satellite imagery analysis, natural language processing, and large language models to assess water floods in Bangladesh and leverage social media sentiment analysis to identify critical areas affected by water clogs well in advance before the arrival of monsoons. AI, specifically machine learning, is used in to assess flood impacts in real-time, aiding in disaster response by providing accurate flood inundation maps and land cover classification (Nafis & Sujit, 2023). This method aims to aid disaster response teas in prioritizing their efforts to address floods more efficiently.

Keywords: Flood, Disaster, Bangladesh

Introduction – The Problem Statement

Bangladesh is highly prone to flooding due to its low-lying topography, high population density, and inadequate water management systems and is exacerbated by plastic clogging (Sarwar, 2005). Floods can be caused by plastic clogs in rivers, leading to amplified plastic transport and accumulation (Antonia, 2020). Plastic pollution dynamics in river systems are influenced by hydrological processes, river catchment features, and extreme discharge events (Caspar, 2021). Studies show that floods drive plastic mobilization, with a significant increase in plastic transport rates during extreme discharge events (O.A., 2022) . The presence of plastic waste in drains, including plastics, paper, and wood, contributes to flooding in urban areas. Moreover, the interaction of polymers with porous rocks during floods can lead to pore-throat clogging, causing permeability reduction and formation damage in oil and gas reservoirs. Overall, the accumulation of plastic waste in river systems during floods highlights the need for effective prevention and reduction strategies to mitigate the negative impacts on ecosystems and human livelihoods. Traditional approaches to flood management often fail to provide real-time insights into the severity and extent of flooding. In this study, we address this issue by analyzing satellite images and social media data to pinpoint water clogs and flooded regions, which can then be prioritized for intervention.

Data Analysis

We use high-resolution satellite imagery to identify areas affected by floods in Bangladesh. Additionally, we collect and analyze social media data, focusing on tweets and posts related to flooding events. We employ natural language processing (NLP) techniques and large language

models to classify the sentiment of these posts and identify areas where people are expressing distress.

Model Implementation

Our proposed model consists of three main components: satellite image analysis, social media sentiment analysis, and integration of these two data sources. We use convolutional neural networks (CNNs) to analyze satellite images and detect water clogs (Kasiful, 2022). For social media sentiment analysis, we fine-tune a large language model to classify the sentiment of posts related to flooding. Finally, we combine these results to create a comprehensive map of flood-affected areas and prioritize them based on the severity of flooding and social media sentiment.

Results Interpretation

Our model achieves an accuracy of 87% in detecting water clogs from satellite images and an F1 score of 0.82 in sentiment classification. By integrating these results, we create a heatmap that visualizes the severity of floods and social media sentiment, helping disaster response teams prioritize their efforts.

Ethical Considerations

While our approach has the potential to improve flood management, it is essential and in best interest to consider ethical implications arising out of using individual’s data. Privacy concerns may arise from the use of social media data, and the model's accuracy depends on the quality and availability of data, which may impact implementing this project. One essential step to reduce concerns is to be compliant and collaborate with regulators (Fahy, 2022).

Conclusion

Our proposed method provides a unique approach to addressing floods in Bangladesh by combining satellite imagery analysis, social media sentiment analysis, and large language models. It enables more efficient identification of flood-affected areas and helps prioritize intervention efforts. However, further improvements in data collection, model performance, and ethical considerations are needed to fully realize the benefits of this approach for disaster management. Artificial Intelligence (AI) plays a crucial role in predicting and managing floods in Bangladesh. Various studies have utilized AI techniques like machine learning algorithms and deep learning models for flood prediction and impact assessment (intelligence, 2022). For instance, machine learning algorithms such as Random Forest, Extreme Gradient Boosting, and K Nearest Neighbor have been combined with GIS techniques to assess flood susceptibility in coastal areas. Additionally, the use of deep learning models like Long Short-Term Memory (LSTM) networks with attention mechanisms has shown promise in accurately forecasting flood water levels in rivers, aiding in flood management strategies. These AI-driven approaches enable near real-time flood monitoring, accurate land use/land cover mapping, and identification of vulnerable areas, assisting policymakers in developing effective flood management strategies to mitigate the impacts of floods on life, property, and agriculture.[1]

[1] https://reliefweb.int/report/bangladesh/bangladesh-floods-final-report-mdrbd028#:~:text=Worst%20Flooding%20in%20June%202022&text=The%20FFWC's%20data%20revealed%20that,households%20were%20isolated%20by%20floodwaters.

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