

MULTI AI SENTINEL: MULTI-AGENT AI FOR PREDICTIVE FLOOD RESPONSE AND AUTONOMOUS RESOURCE ALLOCATION

P. Rithika^{1*}

1. PG Student, Department of Computer Science, Velumanoharan Arts and Science College for Women, Ramanathapuram, Tamil Nadu, India

Abstract

Floods are common natural disasters that affect people, infrastructure and the availability of essential resources, and identifying affected areas and providing the required support at the right time is challenging. To address this issue, this paper introduces Bharat AI Sentinel, a software-based system designed to support flood monitoring and emergency resource management. The system uses flood, weather, population and geographical data to identify areas affected by flooding and assess the level of impact. Based on this information, it estimates the number of people who may require assistance and the number of rescue teams needed, and it supports the allocation of essential resources, including food, water, medical kits and rescue teams, according to the estimated requirements. After allocation, the system records the updated quantities so that the remaining resources are available for subsequent allocation. Python is used for the artificial intelligence (AI) and machine learning (ML) processes, while PostgreSQL is used for data storage and management. In a case application to Kilakarai, the system classified flood severity as medium, estimated 500 of 1,000 residents as affected, allocated all required resources without shortage and identified an accessible evacuation route. The proposed system is intended to provide useful information to emergency response teams and help them plan rescue activities and resource distribution in a more organised and efficient manner.

Keywords

Flood Monitoring, Artificial Intelligence, Machine Learning, Disaster Management, Resource Allocation, Emergency Response, Geographical Data, Multi-Agent System

1. Introduction

Floods are frequent natural disasters that can cause serious damage to human life, infrastructure, transportation and essential services [1], [3], [10]. During such emergencies, identifying affected areas, estimating population needs and allocating limited resources manually is challenging, and international frameworks emphasise the need for better preparedness and data-driven response [2]. Artificial intelligence (AI) and machine learning (ML) can analyse flood, weather, population and geographical data to support disaster response planning [5].

This paper proposes Bharat AI Sentinel, a software-based disaster response and resource management system. The system assesses flood severity,

estimates the affected population and calculates the requirements for rescue teams, food, water and medical resources, while maintaining the remaining resource quantities for future allocation. It combines AI/ML-based analysis with a user-friendly application to provide data-driven support for emergency planning and resource coordination, assisting rather than replacing human decision-making. The main contributions are flood-impact assessment, estimation of the affected population, rescue-team planning, systematic resource allocation and resource tracking for subsequent emergency needs.

2. Statement of the Problem

Flood disasters create major challenges in identifying affected areas, estimating the population

*Corresponding author: rithi2703@gmail.com

requiring assistance and allocating limited emergency resources. Manual disaster management can be time-consuming and may lead to improper distribution of food, water, medical supplies and rescue teams. There is therefore a need for a software-based system that analyses flood-related data, assesses the severity of impact, estimates resource requirements and maintains updated resource information to support organised, data-driven disaster response planning.

3. Objectives of the Study

1. To assess flood severity and estimate the affected population in vulnerable areas using flood, weather, population and geographical data.
2. To calculate the rescue teams and essential resources (food, water and medical supplies) required and support their systematic allocation.
3. To maintain updated information on remaining resources and provide data-driven support for emergency response planning and coordination.

4. Review of Literature

Previous studies have explored the use of AI, ML and geographic information systems (GIS) for flood prediction and disaster management. ML techniques have been applied to rainfall, weather and geographical data to identify flood-prone areas and predict flood severity [4], [5], drawing on models such as random forests, gradient boosting and long short-term memory networks [6]–[8]. GIS and remote-sensing approaches have supported the visualisation and mapping of affected regions [4], [9], while other research has focused on estimating disaster impacts and vulnerability [13]. However, many existing approaches focus mainly on prediction or mapping and provide limited support for integrated resource allocation and tracking. Building on these observations, Bharat AI Sentinel combines flood-impact assessment, estimation of the affected population, calculation of resource requirements

and resource tracking within a single software-based system.

5. Research Methodology

The proposed system follows a software-based, data-driven methodology for flood response planning. Flood, weather, population and geographical data are collected and processed as input and analysed using AI/ML techniques to determine the flood severity level and estimate the affected population. Based on the estimated impact, the required number of rescue teams and essential resources such as food, water and medical supplies are calculated, and the allocated resources are updated to maintain the remaining quantities for future requirements. The results are presented through a user-friendly software application to support emergency response planning and resource coordination.

The system draws on five categories of digital data: weather data on rainfall and conditions related to flood risk; population data for estimating the affected population [11]; geographical data on the location and characteristics of vulnerable areas [12]; flood data on severity and impact; and satellite/GIS data for visualising and identifying flood-prone locations. Python and Flask are used for data processing, analysis and application development, and PostgreSQL is used for data storage.

Scope: The study focuses on developing a software-based system to support flood response and resource management. It can be extended by integrating real-time weather data, satellite imagery, GIS technologies and advanced AI/ML models to improve flood prediction and emergency response planning.

6. Results and Discussion

The system was applied to Kilakarai to demonstrate flood-severity assessment, resource allocation, risk assessment and route analysis (Tables 1–4).

Table 1. Flood Severity and Population Impact

Area	Flood Level	Severity	Total Population	Affected Population	Vulnerability
Kilakarai	5/10	Medium	1,000	500	High

Source: System-generated data

Kilakarai has a medium flood severity with a flood level of 5/10. Of the total population of 1,000, approximately 500 people are estimated to be affected. The vulnerability score of 50/100 indicates a high vulnerability level and the need for evacuation and emergency support.

Table 2. Resource Allocation and Availability

Resource	Available Before	Required	Allocated	Remaining	Shortage
Food	3,000	1,000	1,000	2,000	0
Water	1,500	1,500	1,500	0	0
Medical Kits	1,450	50	50	1,400	0
Rescue Teams	4	1	1	3	0

Source: System-generated data

The system allocated all required resources without any shortage. One rescue team is required, while four teams are available. Food, water, medical kits and rescue teams were allocated according to the estimated requirements, and the remaining quantities were maintained for future emergencies.

Table 3. AI Risk Assessment

Risk Factor	Contribution
Flood Contribution	20/40
Population Contribution	3/30
Rescue Contribution	5/20
Shortage Contribution	0/10
Overall Risk Score	28/100

Source: System-generated data

The overall AI risk score for Kilakarai is 28/100, which the system classifies as low risk. Flood intensity contributes the highest individual component (20 points), while no risk is added for resource shortage because all required resources are available.

Table 4. AI Rescue and Route Analysis

Parameter	Result
Rescue Teams Required	1
Available Teams	4
Recommended Road	East Relief Road
Distance	6.2 km
Road Status	Open
Response Time	6–12 hours
Shelter Requirement	1 shelter

Source: System-generated data

The system recommends deploying one rescue team and identifies East Relief Road, at a distance of 6.2 km, as the recommended accessible route. The emergency action plan includes evacuation preparation, shelter coordination, medical support and resource monitoring.

7. Findings

1. The system classified the flood severity in Kilakarai as medium (5/10) and estimated that approximately 500 of the 1,000 residents were affected; the vulnerability score of 50/100 indicates high vulnerability.

2. One rescue team was identified as the required response capacity, and all required resources were allocated with zero shortage; after allocation, 2,000 food units, 1,400 medical kits and three rescue teams remained available.

3. The overall AI risk score was 28/100 (low risk), and East Relief Road (6.2 km) was identified as the recommended accessible emergency route.

4. The system provides an organised approach to flood assessment, resource allocation, tracking and emergency response planning.

8. Limitations and Suggestions

The accuracy of flood assessment depends on the quality and availability of input data such as weather, population and geographical information. The system provides estimated resource requirements that may not fully represent the actual situation during a disaster, it does not collect real-time field information directly, and it is designed to support – not replace – decisions made by disaster-management authorities.

The system can be improved by integrating real-time weather and rainfall data, live satellite imagery and GIS data; using advanced AI/ML models and historical flood data to improve impact prediction and population estimation; providing real-time resource availability and allocation updates; adding alerts and notifications for emergency response teams; developing mobile application support; and extending the system to multiple regions and

countries.

9. Conclusion

Bharat AI Sentinel provides a software-based approach for improving flood response and emergency resource management. The system analyses flood, weather, population and geographical data to assess flood severity and estimate the affected population, and it calculates the requirements for rescue teams, food, water and medical resources while tracking the remaining quantities after allocation. By combining AI/ML-based analysis with a user-friendly application, it supports organised and data-driven disaster response planning, assisting emergency teams in decision-making rather than replacing human judgement. Future enhancements such as real-time data integration, satellite imagery and advanced AI/ML models can further improve its effectiveness.

References

- [1]. World Health Organization. (n.d.). Floods. WHO.
- [2]. United Nations Office for Disaster Risk Reduction. (2015). Sendai framework for disaster risk reduction 2015–2030. UNDRR.
- [3]. Intergovernmental Panel on Climate Change. (2022). Climate change 2022: Impacts, adaptation and vulnerability. Cambridge University Press.
- [4]. Tehrany, M. S., Pradhan, B., & Jebur, M. N. (2014). Flood susceptibility assessment using a novel ensemble weights-of-evidence and support vector machine models in GIS. *Journal of Hydrology*, 512, 332–343.
- [5]. Mosavi, A., Ozturk, P., & Chau, K.-W. (2018). Flood prediction using machine learning models: Literature review. *Water*, 10(11), Article 1536.
- [6]. Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. *Neural Computation*, 9(8), 1735–1780.
- [7]. Breiman, L. (2001). Random forests. *Machine Learning*, 45(1), 5–32.
- [8]. Chen, T., & Guestrin, C. (2016). XGBoost: A scalable tree boosting system. In *Proceedings of*

- the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (pp. 785–794).
- [9]. Bates, P. D. (2004). Remote sensing and flood risk management. *Natural Hazards and Earth System Sciences*, 4, 359–367.
- [10]. Seneviratne, S. I., et al. (2012). Changes in climate extremes and their impacts on the natural physical environment. In *Managing the risks of extreme events and disasters to advance climate change adaptation* (pp. 109–230). Cambridge University Press.
- [11]. United Nations, Department of Economic and Social Affairs, Population Division. (n.d.). *World population prospects*. United Nations.
- [12]. OpenStreetMap Foundation. (n.d.). OpenStreetMap [Online geographic database].
- [13]. Balica, S. F., Wright, N. G., & van der Meulen, F. (2012). A flood vulnerability index for coastal cities and its use in assessing climate change impacts. *Natural Hazards*, 64(1), 73–105.