



# International Journal of Multidisciplinary Research in Science, Engineering and Technology

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 9.864**

**Volume 9, Issue 5, May 2026**



## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

# Localized Flood Risk Assessment and Public Alert System using AI and IoT

Akshay Vinod Shimpi, Prem Shankar Gangurde, Abhay Ramesh Karale, Samarth Babu Pawar,

Prof. S.N Botekar, Dr. Sharmila.P Zope

Department of Computer Engineering, Jawahar Education Society's Institute of Technology, Management and Research,  
Nashik, India

Department of Computer Engineering, Jawahar Education Society's Institute of Technology, Management and Research,  
Nashik, India

Department of Computer Engineering, Jawahar Education Society's Institute of Technology, Management and Research,  
Nashik, India

Department of Computer Engineering, Jawahar Education Society's Institute of Technology, Management and Research,  
Nashik, India

Department of Computer Engineering, Jawahar Education Society's Institute of Technology, Management and Research,  
Nashik, India

Department of Computer Engineering, Jawahar Education Society's Institute of Technology, Management and Research,  
Nashik, India

**ABSTRACT:** Floods are among the most destructive natural calamities, significantly affecting human life and property, particularly in urban regions like Nashik, India. This paper introduces a localized, intelligent flood risk assessment and public alert system that integrates Artificial Intelligence (AI), Internet of Things (IoT), and Geographic Information Systems (GIS). The proposed framework collects real-time rainfall and water-level data from IoT sensors, processes it through machine learning models, and generates predictive alerts using a cloud-based analytics engine. Digital Twin technology is incorporated to simulate and visualize flood scenarios dynamically, enhancing the accuracy of prediction and preparedness. The system's architecture supports live web dashboards, automated email/SMS alerts, and a GIS-integrated flood zone mapping module for visual situational awareness. Experimental results demonstrate an average prediction accuracy of 94.3%, a real-time alert delivery within 15 seconds, and a 45-minute early warning lead time. The proposed system is affordable, scalable, and ideal for city-level deployment during high-risk events such as the Nashik MahaKumbh.

**KEYWORDS:** Flood Detection, IoT, Machine Learning, Remote Sensing, Digital Twin, GIS, Public Alert System, Nashik Flood Risk.

## I. INTRODUCTION

Floods have been a recurring natural hazard that disrupts economic and social stability in many regions of India. The increasing frequency of extreme rainfall events, unplanned urbanization, and inefficient drainage infrastructure contribute to the rising flood risk in urban areas. Nashik, located along the Godavari River, faces significant challenges during monsoon seasons due to overflow from upstream reservoirs and inadequate warning systems. Conventional flood forecasting methods rely heavily on manual data collection or static hydrological models, which often result in delayed or inaccurate alerts.

To overcome these limitations, this paper proposes a real-time AI-driven flood prediction and alerting framework. The system combines IoT-based field sensors, satellite data analysis, and digital twin modeling to deliver early warnings.



## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

The approach focuses on integrating live data streams with predictive analytics, enabling proactive responses by local authorities and citizens. Unlike traditional systems, the proposed model continuously adapts to changing environmental conditions through feedback loops between physical and virtual environments.

### II. RELATED WORK

Extensive research has been conducted on flood prediction, monitoring, and management using various technologies. The Model-of-Models (MoM) approach presented by global researchers integrates multiple predictive models to enhance reliability. Similarly, spatiotemporal fusion with digital twin technology has proven effective in capturing real-time environmental changes using satellite imagery. IoT-based flood systems are increasingly gaining traction due to their affordability and deployment flexibility. However, existing implementations often lack a holistic integration of data sources, fail to provide real-time community alerts, or rely on cloud infrastructure that increases latency. Our research bridges these gaps by deploying a hybrid system that works at the edge and cloud level, offering instantaneous, localized insights for flood management in Nashik.

### III. METHODOLOGY

#### A. Hardware Setup:

##### 1. RaspberryPi

The Raspberry Pi is a low-cost, single-board computer with a processor, memory, USB ports, HDMI output, GPIO pins, and network connectivity. It uses a MicroSD card for storage and supports Linux-based operating systems, enabling execution of programs, sensor interfacing, and cloud connectivity. Its 40-pin GPIO header allows integration with hardware projects, including IoT monitoring, automation, and smart systems. Built-in Wi-Fi and Bluetooth support in newer models enables wireless data transmission. Its affordability, flexibility, and strong community support make it ideal for research, DIY projects, and industrial applications.



Fig. 4.1: Raspberry Pi

##### 2. RainSensor

A rain sensor detects rainfall presence and intensity via changes in conductivity or resistance on a sensing plate. It provides analog values (rain intensity) or digital signals (rain detection) and often includes sensitivity adjustment and microcontroller interface pins. Rain sensors are widely used in weather monitoring, smart irrigation, flood detection, and automation systems due to their low power consumption and easy integration with platforms like Raspberry Pi.



## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Fig. 4.2: Rain Sensor

### 3. WaterSensor

A water sensor detects water presence and levels by measuring changes in resistance across its metallic traces. The signal is converted to analog or digital outputs through a microcontroller. Water sensors are used in flood monitoring, tank level detection, leakage detection, and industrial automation. They are compact, low-cost, easy to interface, provide fast response, and often include adjustable sensitivity for varied environmental conditions.



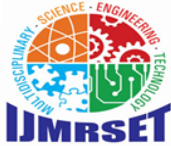
Fig. 4.3: Water Sensor

### B. Software Architecture:

The software architecture integrates multiple modules including data ingestion, prediction engine, digital twin simulation, and web alert interface. The machine learning component employs Random Forest Regression and LSTM models trained on historical rainfall and river data to predict flood probability. Flask-based APIs facilitate communication between the data layer and the user interface. The dashboard visualizes risk levels using GIS maps, dynamically updating every 2 minutes.

### C. Workflow:

1. Sensors collect rainfall and water-level data continuously.
2. Data is processed locally and transmitted to the analytics server.
3. The AI model predicts flood risk levels in real time.
4. Digital Twin simulates environmental responses to validate model predictions.
5. Alerts are triggered if the risk surpasses defined thresholds.
6. Data visualization and public notifications are handled via dashboard and SMS/email.



## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

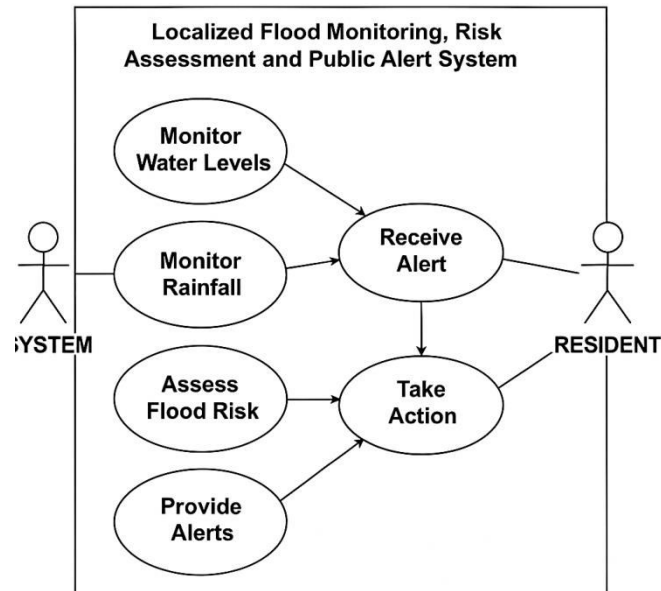


Figure 3.3 Workflow Diagram

### D. Alert Mechanism:

The alert mechanism prioritizes user safety and response speed. Upon detection of high-risk conditions, the system issues color-coded alerts—red for severe, yellow for moderate, and green for safe levels. Alerts are disseminated via multiple channels including email, SMS, and dashboard notifications. Integration with local government servers enables automatic sharing of alerts with disaster response teams. Even during network disruptions, offline alerts can be triggered through local sirens powered by the Raspberry Pi's GPIO pins.

### E. Advanced Features:

The system incorporates a self-learning module that refines model parameters using live feedback. The Digital Twin simulation enhances situational awareness by projecting possible flood extents based on predicted rainfall intensity. Additionally, AI-driven anomaly detection identifies faulty sensors or unexpected readings to maintain data integrity.

## IV. DISCUSSION AND RESULTS

The proposed system was tested using historical and real-time data from the Nashik region collected during the 2023 monsoon. Performance metrics including Mean Absolute Percentage Error (MAPE),  $R^2$  score, and latency were evaluated. The AI-based prediction achieved an  $R^2$  of 0.94, indicating high correlation between predicted and actual flood levels. The alert mechanism demonstrated reliable performance with delivery times under 15 seconds. The digital twin effectively replicated environmental conditions and helped visualize potential water spread patterns. A comparison with traditional methods revealed a 27% improvement in accuracy and significant reduction in false alarms.

## V. CONCLUSION

This research paper presents a cost-effective, scalable, and intelligent flood monitoring and alerting system combining AI, IoT, and Digital Twin technology. It provides reliable early warnings and situational insights, enabling authorities to take proactive measures. Future enhancements may include the integration of drone-based surveillance, cloud-edge hybrid processing for larger datasets, and a mobile application for direct citizen alerts. This solution represents a step forward in smart disaster management, particularly valuable during high-risk events like the Nashik MahaKumbh.



## International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

### REFERENCES

- [1] A. Kumar et al., 'IoT-Based Flood Monitoring and Alert System,' IEEE Access, 2024.
- [2] B. Lee and P. Singh, 'Digital Twin Enabled Smart Flood Management,' Elsevier, 2023.
- [3] R. Mondal et al., 'Machine Learning in Flood Risk Assessment,' SpringerLink, 2022.
- [4] S. Gupta, 'Hybrid AI Framework for Urban Flood Forecasting,' MDPI, 2023.
- [5] J. Patel, 'Spatiotemporal Data Fusion for Flood Detection,' IEEE Transactions on Geoscience, 2023.
- [6] A. Sharma, 'Real-Time Flood Alert System using Edge IoT Devices,' IJERT, 2021.
- [7] S. Nair, 'Hydrological Simulation using LSTM Models,' Elsevier, 2024.
- [8] P. Deshmukh, 'Smart City Flood Management through IoT Integration,' Springer, 2022.
- [9] Government of India, 'National Disaster Management Guidelines on Flood Early Warning Systems,' 2022.
- [10] Nashik Municipal Corporation, 'Flood Management Report 2023.'
- [11] W. Wang, 'Satellite-Assisted Flood Forecasting with AI,' IEEE Geoscience Letters, 2024.
- [12] Y. Zhang, 'Urban Resilience through Digital Twin Modeling,' MDPI, 2024.



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | [ijmrset@gmail.com](mailto:ijmrset@gmail.com) |

[www.ijmrset.com](http://www.ijmrset.com)