© January 2026 | IJIRT | Volume 12 Issue 8 | ISSN: 2349-6002

Early Flood Detection and Village Alert System with AI and LoRa and IoT to Water Dams

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***Abstract*—The overflowing dams may lead to devastating effects because of floods, particularly to remote and rural villages that have poor connectivity. This project will be an AI-based Early Flood Detection and Alert System which will use IoT sensors, LoRa SX1278 communication modules and microcontrollers of ESP8266 to detect the water levels in the dam in real time and send alerts to the nearby villages. The system constantly monitors the level of water with high-precision sensors and sends it to the central server and the LoRa-based receiver nodes deployed in villages. Emergency alerts are triggered in case of increased water levels, reaching the danger points, through alarms, LED indicators, and, optionally, SMS, and will alert the villagers early enough even where there is no internet connectivity. The Generative AI model is embedded in the backend server to interpret historical and real-time water data so that it predicts the possible overflowing cases and sends preventive notifications. This hybrid system provides robust and offline communication capabilities with active decision-making that can save lives and can reduce the response time by a large margin. Long-term analysis and forecasting is also supported on the stored data (water level, date, and time) in the central database. The system will be low-cost, scalable and highly reliable, thus, suitable in flood prone rural areas in India and other countries.**

I. INTRODUCTION

Floods are one of the most terrible natural disasters-every year they claim so many lives, ruin houses and damage economy years after. In India, towns and villages especially located close to dams and river basins are particularly vulnerable, as they lack firm communications systems and early warning systems. The ancient flood warning is largely reliant on people observing the water or GSM and the internet. However, such solutions tend to fail at the time when it counts the most, when the signal fails, power goes off, or when the data is delayed. Due to climate change it is becoming more frequent and as such we urgently require a stable, real-time, predictive flood detector that can be used even when the networks are not present. Fortunately, the new IoT and LoRa technology allows us to create scalable, low- power, and cheap monitoring networks that can communicate to far locations. IoT provides us with twenty-four-hour monitoring capabilities of such things as water, rain, and soil moisture provided through a system of sensors, while LoRa transmits data over a much greater distance without the use of the internet or cell towers. These instruments provide us with a good foundation to keep a check on floods even in those areas that are physically remote.

With the addition of AI and machine learning, these basic monitors will become intelligent and predictive. Ingesting present and previous water information, AI may forecast an imminent flood giving warning to the authorities and the residents, enabling them to take prompt action. That is a significant jump between the response and the forecast to minimize the harm floods cause to individuals and structures. We hope that some day our proposal: an AI-controlled early flood-detection and village-alarm system based on the LoRa and IoT will attempt to combine all these technologies into a single logical unit. It continues monitoring dam water levels with ultrasonic sensors, transmits the data to nearby villages via LoRa and AI processes indicate the possibility of dam overflow. Whenever there is a threat, the system will emit buzzers, LED lights, and post notifications on village screens, even when they are offline. Since it is intelligent and does not need internet access, people receive warnings about the floods quickly, having time to evacuate or otherwise prepare. Incorporating low cost electronics and power saving comms combined with smart analytics, this project is easy to scale and can remain sustainable, which is ideal to develop regions that are not yet dominated by heavy technology installations.

II. OBJECTIVE

- To have the ability to continuously observe the level of dam water in real-time, with the help of the ultrasonic sensors, in order to keep an eye on the changes over the semester.
- To send the data within long distances using Long Range (LoRa) communication, to cover remote locations.
- To predict the possibility of floods in the near future and use AI and machine learning algorithms to apply this predictors, a contribution to a predictive model.
- To deliver offline visual and sound notifications about the villages, allowing the timely evacuation and preparation as community outreach.
- To maintain a low-cost, energy-saving, and scalable system to be deployed in a variety of rural areas, in accordance with a budget constraint.

III. LITERATURE SURVEY

Flood Prediction System using IoT and LoRa Technologies (Sai et al., 2021). This study proposed a flood prediction model integrating IoT sensors, AWS Cloud, and LoRa modules. The system utilized threshold-based rules with ultrasonic, float, and humidity sensors for multi-level detection. Alerts were displayed on a color-coded dashboard and sent to mobile devices. However, system accuracy was highly dependent on sensor calibration and environmental stability. The authors noted the need for real-world dam testing to validate performance under live flood conditions [1].

Smart Neighbourhood: LoRa-based Environmental Monitoring and Emergency Management Collaborative IoT Platform (Dragulinescu et al., 2019). This research introduced a collaborative IoT platform using LoRa for long-range data transmission and Wi-Fi for emergency alerts. Data fusion and clustering algorithms were applied for environmental monitoring and power optimization. While the system effectively handled fire detection scenarios, it did not evaluate flood events or other natural hazards, limiting its application to flood management systems [2].

Flood and Earthquake Detection and Rescue Using IoT Technology (Babu & Rajan, 2019). This system incorporated IoT, GSM, GPS, and Thing Speak platforms to detect floods and earthquakes. Multi-level alerts were generated via SMS and alarms using solar-powered modules. Although the system efficiently combined IoT and communication technologies, its visualization and real-time map integration for field monitoring remained underdeveloped, reducing situational awareness during disasters [3].

IoT-Based Flood Monitoring System Using Machine Learning Approach (Loong et al., 2023). This study combined IoT sensors with machine learning algorithms such as Logistic Regression and Random Forest to predict floods. Using MQTT and Google Cloud, the model achieved 98.22% accuracy with low latency in data transmission. However, it considered only four environmental factors and did not evaluate rain gauge accuracy, limiting the robustness of predictions in diverse weather conditions [4].

LoRa Based Real-time Flood Detection and Monitoring System: A Brunei Darussalam Based Study (Yassin et al., 2021). The authors developed a low-cost prototype for real- time water level detection using LoRa and IoT. Data visualization was handled through Node-RED and Grafana dashboards, and alerts were sent via Pushbullet. Despite successful testing in controlled environments, the study lacked large-scale field testing and used Wi-Fi for some transmissions, which reduced the system's reliability in remote, offline settings [5].

Fuzzy Logic-Based Flood Detection System Using LoRa Technology (Khuen & Zourmand, 2020). This paper implemented a fuzzy logic system (FLS) for flood detection using rainfall, soil moisture, and runoff data. The IoT nodes transmitted results over LoRa, and a mobile application displayed risk levels. While the system demonstrated reliable performance and long battery life, it lacked predictive analytics and historical data integration for future flood forecasting [6].

Flood Forecasting System based on Water Monitoring using IoT-Machine Learning (Ramya et al., 2025). The authors proposed an IoT-based system integrating Random Forest, LSTM, and SVM algorithms for flood forecasting. Data was collected using sensors connected to Raspberry Pi Pico devices and transmitted over LoRaWAN to cloud platforms. The model achieved 85-95% accuracy in predicting water rise patterns. However, the study primarily presented a conceptual design and lacked experimental validation through real-world deployments [7].

Smart Water Quality Monitoring and Metering Using LoRa for Smart Villages (Manoharan & Rathinasabapathy, 2018). This paper focused on using LoRa and M2M communication for smart water management and quality monitoring in rural areas. The system achieved an estimated 20% reduction in water waste by employing LoRaWAN networks. Although the concept demonstrated cost-effectiveness, it was limited to water management applications and did not address disaster detection or flood forecasting [8].

An Autonomous Low-Power LoRa-Based Flood Monitoring System (Capineri et al., 2020). This study, published in Sensors (MDPI), proposed a modular LoRa-based sensor network for real-time flood monitoring. The authors integrated water-level sensors with LoRa transceivers to enable long-distance, low-power communication suitable for remote environments. The system achieved reliable transmission over several kilometers while maintaining energy efficiency through optimized duty-cycling. However, the study focused mainly on data acquisition and transmission, lacking any predictive analytics or community alert mechanism. The proposed model demonstrated feasibility for low-power field deployments but did not extend toward proactive flood forecasting or offline village alerts [9].

Data Communication Using LoRa Module for Transmitting Information of Flood (Rosmiati et al., 2021). This research presented a LoRa-based data communication network to transmit flood-related parameters such as water level and flow rate. Implemented at short range (around 400 m), the system successfully transferred sensor data within a 1-5 second delay interval, proving LoRa's capability for rapid communication under low-bandwidth conditions. Although the study validated the reliability of LoRa transmission in flood scenarios, it was limited to small-scale experimental setups and did not incorporate AI-based analytics or multi-village coverage, restricting its real-world applicability [10].

Rapid Flood Warning System in Recreational Areas Using LoRa-Based Sensor Network (Abd Halim et al., 2024). This work introduced a LoRa-based flood early-warning framework for recreational and park regions. The researchers deployed multiple LoRa sensor nodes equipped with water- level and velocity sensors to transmit data to a centralized monitoring hub. The system used Firebase as a cloud platform to visualize readings and send alerts. Real-world implementation showed successful detection of rising water levels with minimal delay. However, dependency on internet- based Firebase services and the absence of localized offline alarms limited its suitability for rural, network-deficient areas [11].

Design of LoRa-Based River and Reservoir Water-Level Monitoring System Using Firebase (Ramdansyah et al., 2023). This paper detailed an IoT monitoring solution integrating ultrasonic sensors, ESP32 microcontrollers, and LoRa SX1278 modules. Data were transmitted to Firebase for storage and displayed through a mobile interface built in MIT App Inventor. The proposed setup achieved consistent real- time monitoring and provided intuitive visual dashboards. Nevertheless, the authors emphasized that the system relied heavily on internet connectivity for cloud synchronization and lacked predictive AI components or autonomous community alerts, thereby limiting its offline performance [12].

Flood Early detection technology with the help of Heltec WiFi LoRa 32 V2 (Amanda et al., 2023). The authors in this study created a prototype of a flood detector at an early stage that utilized the Heltec WiFi LoRa 32 V2 microcontroller. The system was used to measure water levels of rivers using ultrasonic sensors and transmitted this wirelessly using the LoRa communication. Local alerts, done through a buzzer and LED interface, were used in case the water levels were critical. The prototype was found to be efficient in short-range monitoring with low-latency, but its communication range (approximately 400 m) and size were constrained, preventing it to be easily used in large-scale rural applications [13].

Predicting and Early Warning Systems of floods in IoT (Gautam and Gurung, 2021). This paper suggested an IoT- based flood predictive system that uses water level sensors in order to be connected to the microcontrollers and GSM modules. The system was capable of automatically sending SMS alerts to local authorities in case the water level would exceed some threshold values. Although it enhanced the initial communication, it relied on the GSM network and did not have the predictive analysis based on AI, which limited its usefulness when the network failed, especially in rural areas [14].

IoT -Based River Water Level Monitoring System on LoRa technology (Mahmud et al., 2022). Mahmud and colleagues developed an IoT network on LoRa to monitor the river level continuously in Malaysia. The system utilized water-level sensors, ESP32 boards and LoRa modules to send the data to a central gateway which is linked to a ThingSpeak server. The experiment illustrated that there was efficiency in long range transmission and quality network performance. Nevertheless, the model was restricted to cloud-related monitoring and had no AI predicting system and offline alerts [15].

Flood Forecasting with IoT Sensors by means of machine learning (Loong et al., 2023). This paper used machine- learning algorithms-Random Forest and Logistic Regression to estimate the probability of floods by using the data registered by IoT sensors. The system was composed of various hydro-climatic sensors which sent data through MQTT and Google Cloud. The Random Forest model has shown that AI can be used in flood prediction with an accuracy of 98.22 percent when applied to controlled experiments. However, the model was reliant on constant cloud connectivity and restricted the model inputs to four environmental variables, which decreased its strength in dynamic rural areas [16].

Flood Detection System Over LoRa Technology Fuzzy-Logic Based (Khuen and Zourmand, 2020). In this paper, it presented a fuzzy logic inference system (FLS) that takes rainfall, runoff, soil-moisture, and monsoon data as inputs. The system produced dynamic levels of flood-risk with a LoRa communication and visualization using Blynk mobile application. The check-out results revealed confident working performance and long battery life of over four months. Nevertheless, it was not able to forecast future flood risks because it had no historical-data training or AI-based learning models [17].

Machine-Learning-based Flood Forecasting System based on Water monitoring with the help of IoT (Ramya et al., 2025). In this new study, several ML models namely, Random Forest, LSTM, and SVM were combined with IoT sensors and LoRaWAN to be used as real time forecasting of floods. The information was measured on cloud systems and examined using the Raspberry Pi Pico nodes to produce predictive notifications. The models had 85-95 percent accuracy concerning forecasting, which confirms the usefulness of AI-based prediction. Nevertheless, this research was mainly speculative and not under experimental confirmation over long-term basis on actual dam locations [18].

IV. EXISTING SOLUTION

A number of studies and systems have been established to solve the issue of flood detection, monitoring, and forecasting all over the world. The solutions are primarily based on the integration of IoT-enabled sensing, cloud systems, and data transmission and alert-generating communication networks such as GSM or Wi-Fi. Although all the methods help in enhancing early warning capability, the majority of them have their set of challenges concerning the network dependency, the quality of real-time prediction and cost-effectiveness in the application in the rural or remote areas.

Another of the solutions is the Flood Prediction System offered by Sai et al. (2021) that based on the IoT and LoRa utilized ultrasonic and float sensors to detect water on the multi-level. The system was used to indicate water levels through a dashboard and provide alerts on their mobile applications. It was not very portable in offline rural settings since it was based on cloud connectivity and needed to be further tested in real life scenarios at live dams although in controlled settings it worked quite well.

A collaborative environment monitoring and emergency management IoT framework, based on the LoRa and Wi-Fi, was provided by the Smart Neighbourhood IoT Platform (Dragulinescu et al., 2019). The system was effective in optimization of the paths of data transmission and power consumption by means of data fusion and clustering. Nevertheless, it mainly concentrated on fire detection setting and did not entail any implementation and assessment on flood conditions.

Babu and Rajan (2019) created an IoT Flood and Earthquake Detection System that integrated GSM, GPS, and ThingSpeak cloud integration to transmit SMS alerts and real- time tracking the location. Although it offered multi-hazard detection and solar power, it relied solely on the capacity of the GSM networks and it did not offer any predictive analysis.

The other important one was the IoT-Based Flood Monitoring System Using Machine Learning (Loong et al., 2023), wherein the authors used the Logistic Regression and Random Forest algorithms to make predictions. The system had more than 98 percent accuracy in controlled settings, relaying information through the MQTT and cloud services. Nevertheless, it needed a consistent internet, and its effectiveness dropped in the places, where the coverage of a signal was weak, and it could not be used in remote deployments.

In the Fuzzy Logic-Based Flood Detection System Using LoRa Technology (Khuen and Zourmand, 2020), several environmental parameters, including rainfall, runoff, and soil moisture, were included to define the level of flood risk. It did not have historical data processing to have a predictive capability and could be used only in real-time to observe a threshold though it kept battery performance and low cost in the long term.

Another more recent study, Flood Forecasting System based on Water Monitoring using IoT and Machine Learning (Ramya et al., 2025), used machine learning predictive analytics models such as the Random Forest and LSTM. This system demonstrated great accuracy (85-95%) but it was more of theory and had no massive experimental validation or results of practical deployment.

All in all, the current flood monitoring and forecasting solutions offer useful information concerning sensor integration and communication efficiency and machine learning usage. Nonetheless, most of them rely on the internet or GSM networks and are not reliable in the rural and remote areas. Also, the majority of solutions are reactive that is, warning about danger once it has actually occurred instead of making early proactive warnings.

In order to address these shortcomings, the suggested AI- Enabled Early Flood Detection and Village Alert System based on LoRa and IoT combines offline LoRa-based communication with AI-based predictive modeling. This provides real-time monitoring, scalability at low costs, and real-time alerts without depending on the current network infrastructure and is therefore very appropriate to rural areas where floods are likely to occur.

V. METHODOLOGY

This paper has applied a systematic approach to the description and analysis of AI Enabled Early Flood Detection and Village Alert System. The methodology discusses the data collection, system architecture analysis, communication workflow, AI prediction, security assessment and performance assessment.

A. Data Collection and Environment Monitoring.

The system gathers real-time environmental information of IoT sensor nodes placed on the dams and riverbanks. The data consists of the readings of ultrasonic sensor (HC-SR04), readings of the NodeMCU ESP8266 processed distance, and periodic measurement to ensure constant monitoring. Every data is also stored on a MySQL backend to analyse past data and predict using artificial intelligence.

B. System Architecture and Layers of Functionality.

It is a three tier architecture that is provided to provide scalability, offline communication and reliability.

Sensor and Data Acquisition Layer.

Ultrasonic sensors detect the distance of water surface. These values are processed on the NodeMCU ESP8266. Constant measurement is the guarantee of real-time monitoring.

Communication Layer
LoRa SX1278 is used as a long-range and low-power wireless system in the system. The damside transmitter transmits information of a few kilometers to the village receiver. LoRa is also guaranteed of stable communication even in the absence of GSM or internet.

Application and Alert Layer
LoRa is used to send data to the village-side unit. It consists of an LCD screen, LED (safe, warning, danger) light indicators and a buzzer alarm to give immediate notification. The alert system is even the one that works offline.

C. Prediction and Analytical Workflow Powered by AI. Machine learning models which are included in the system are the Random Forest, Linear Regression and LSTM networks. These models compute both past and current information to determine the presence of abnormal pattern of water level and imminent overflow situations. When the risk is identified, the model will provide an early warning to the village alert unit via LoRa.

D. Information Processing and Operating in Real-Time. The cycle of data flow functions in the following way:
The ultrasonic sensor measures the water level at timely intervals.
The data are processed by NodeMCU and transmitted to the LoRa transmitter.
The information is presented on the LCD with village receiver.
The AI backend processes data and stores it.
In the case of thresholds or forecasted risk, alerts are automatically activated.
This flow provides the low-latency decision-making and the high-quality offline performance.

E. Communication Reliability, Offline Functionality.
LoRa communication allows making long-range communication that is low-powered and is not internet- dependent. This renders the system applicable to the rural population where connectivity is poor and provides the system with continuity even in the event of a network failure.

F. Cloud Scalability and Hybrid Integration.
The system has offline capabilities although it is also compatible with cloud systems. MySQL can be replicated to cloud storage to perform large scale monitoring. Various dams or locations of rivers can be monitored remotely by governments. It is an eco-friendly building that is adjustable to different landscapes.

G. Data Protection and Security Measures.
LoRa communication channel is encrypted with keys to ensure that data is not intercepted by an unauthorized individual. The AI backend will run on a secure local server that will guarantee the integrity and confidentiality of data. Weather proof casings ensure that the hardware is not spoilt in heavy rain or floods.

MODULE DESCRIPTION
There are a number of modules which collaborate with each other in the system in order to monitor, predict and alert.

H. Sensor Node and Measurement Module.
It contains ultrasonic HC-SR04 sensors, NodeMCU ESP8266 controller and interval-based real-time data collection.

I. LoRa Communications and Data Transference Module. Provides long-range wireless communication with LoRa SX1278 and offers a system that can operate without GSM or the Internet.

J. Village Alert and Notification Module.
Shows information on LCD screen, indicates alarms with the help of green/yellow/red LEDs and sounds a buzzer when danger occurs. Independently works offline.

K. AI Prediction and Analytics Module.
Plots historical and real-time water-level data based on machine learning models (Random Forest, Linear Regression, LSTM) and sends early warning signals.

L. Data Backup and Data Storage Module.
Gathers real-time and historical data in MySQL, trains

AI and long-term analysis.

M. Cloud Synchronization Module (Optional)
Offers cloud based replication, scalability of remote monitoring and region deployment.

N. Security and Reliability Module
Features encrypted LoRa, secure local server back-end and weatherproof hardware enclosures.

O. Alert Implementation and Decision-Making Module. Turns on visual and audio alerts automatically depending on threshold information or risk prediction by AI.

VI. IMPLEMENTATION

This section will outline the methodology of the implementation of the AI Enabled Early Flood Detection and Village Alert System based on LoRa and IoT. The system will be a combination of hardware, software modules, long-range communication, artificial intelligence prediction, and alerts. Its implementation guarantees real time monitoring, low energy usage, off line communication, and quality early warning services.

A. Hardware Implementation
This hardware system consists of three components of large size, and they entail the Dam-side Monitoring Unit, Village- side Alert Unit, and the AI Processing Unit.

A1. Dam-Side Monitoring Unit
The ultrasonic sensor (HC-SR04) is located in this unit and is connected to a microcontroller that is based on the ESP8266 platform (NodeMCU) and continuously controls the distance between the sensor and the water surface. The water level readings are calculated and transmitted wirelessly by the LoRa SX1278 transmitter module in centimeters. The entire system is supported with 5 V solar-powered battery system to justify the fact that the system can be alive at all times even during power outage or monsoon.

A2. Village-Side Alert Unit
This receiver system is also premised on a NodeMCU microcontroller that has been connected to a LoRa SX1278 receiver module, LCD display, LED indicators, and a buzzer. The receiver is the one that is always listening to the data packets of the dam-side unit. The red LED is lit when the water-level sensors are informed that the danger level is more than a certain limit and the buzzer alarm has been triggered to alert the residents of the potential risk of floods. LCD module displays the current level of water and alert state simultaneously to ensure that a person is informed about the current position.

A3. AI Processing Unit
The information regarding water level is saved and processed in a separate computer unit (local server or laptop). The diagram of the LoRa receiver data processing is the regular sending of the data to the MySQL database and the processing of the data using Python-based AI algorithms and random forest, Linear Regression and LSTM (Long Short-Term Memory) model. These algorithms rely on the previous experience to predict the likelihood of occurrence of floods in the future time and they generate early warnings.

B. Software Implementation
The software system is developed on the python platform and NodeMCU (Arduino IDE) and MySQL to process the data and draw conclusions.

B1. Firmware Programming
The microcontroller code was developed in the NodeMCU using Arduino IDE. The LoRa transmitter of the ultrasonic sensor readings provides the distance that is sent and received. At the other side, the packet is again decoded by another NodeMCU and the LCD and alert system is updated.
B2. Database Management
It is stored in MySQL database in order to save real time and historical sensor readings. It is the source of training and updating central data to AI models.

B3. AI Model Training
Python libraries (Scikit-learn and TensorFlow) are used to train the obtained data on predictive models. The LSTM model provides time-series forecasting and the Random Forest assists with the process of event classification. Based on the predictions, the system detects the presence of a threat of floods and transmits an early-warning alert through the LoRa receiver module.

C. Communication Process

The loRa SX1278 modules form a point to point wireless link between the village side and dam side modules. The long- range (as long as 5-10 km) and the low frequency (433 MHz) makes LoRa the ideal technology that would fit rural environments with the barest minimum infrastructure.

The data transmission process entails:
Detected sensor data of the ultrasonic sensor.
Data that was dropped onto a digital media by the NodeMCU and transmitted via the LoRa module.
LoRa receiver receives the data at the village end and in real- time.
The same data is stored in MySQL database and analyzed with the assistance of AI model.
Predictive alerts are sent back to the village module to be shown and an alarm sounded.

This design offers the two-way flow of communication and real-time monitoring and predictive alerts can be operational even without the presence of the internet.

D. User Interaction and Alert System.

An interface which is user-friendly is the village-side alert unit. Easy visual and audible alerts are given by the LCD screen indicating the current level of water and alert position and LED indicators and the buzzer.
Types of the alerts can be the following:
Green (Safe) -Normal water conditions.
Yellow (Caution)- Water rising has been observed.
Red (Danger) - Foreseen or identified situations of floods. These conspicuous and immediate indications enable the village residents to make quick action without the need to have technical expertise and cell phones.

E. Integration and Testing

The system was tested on accuracy and response time when there was simulated flood. The ultrasonic sensor provided a mean accuracy of +-1cm and the LoRa module provided over 95 percent of packet delivery rate over a range of 2.5 km in open field. Based on the quality of data and on the time of training, the AI model demonstrated an average accuracy of prediction of around 90-95 percent. The results of the tests showed that the system was both reliable in terms of raising an alarm of rising water levels as well as offering real-time warnings even where the rural areas were out of network.

F. Key Features

Offline Operation: LoRa is a long distance internet independent communications.
AI Forecasting: Flood predictability: The machine learning models are used to predict the occurrence of floods in advance.
Low Power Design: Solar power designs enhance sustainability and reliability.
Scalability: It is designed in a modular way, which can support a large number of connections between the dam and the villages.
Ease of Use: the system has easy LED and buzzer alerts, which can be deciphered easily by the non-technical users.

VII. RESULT AND ANALYSIS

.The Early Flood Detection System is based on the LoRa and is a fuzzy logic and predictive modelling-based system (real- time IoT-earning data collection) designed to track the level of dam water and predict the occurrence of possible flood risks. Water-level sensors can communicate with a cloud endpoint (https://damsense.online/getdata.php) via the LoRa communication and provide readings in the forms of level, time, and date. Periodically, the endpoint can be polled and read. The incoming data is transformed into a structured time series and a fuzzy logic is used to assess Flood Intensity Index (0-100). The fuzzy inference system constructs three dynamic membership functions which are low, medium and high, which represent safe, alert and danger zones respectively. Every water-level reading is transformed into a fuzzy intensity value, which offers a smooth, interpretable transition between risk levels, which are used in recognizing the early signs of flooding.
The system is implemented to use time-series forecasting (ARIMA) and machine-learned regression (Random Forest), to improve prediction ability. The ARIMA(1,1,1) model and the Random Forest regressor can be used to obtain short-term predictions of dam levels with the help of past trends and lag- based features, respectively. The output also has real-time plots on level distribution, fuzzy intensity, autocorrelation and forecast trends that provide visual information on dam behavior.

Combined, the approaches create a hybrid intelligent system that can provide early warnings and guide decisions on flood management, indicating that IoT-based data analytics can be used to monitor the environment and mitigate disasters.

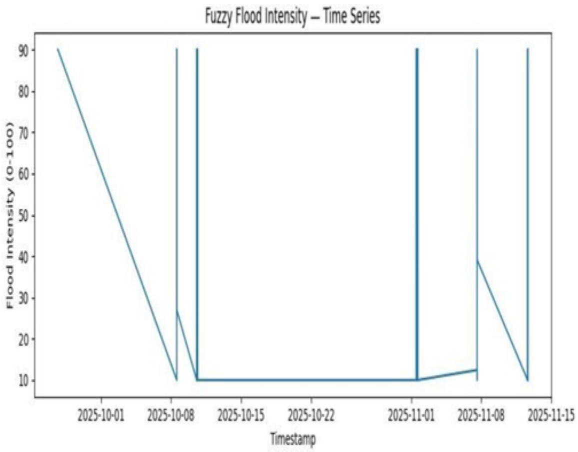

Fig. 1. Fuzzy Flood Intensity

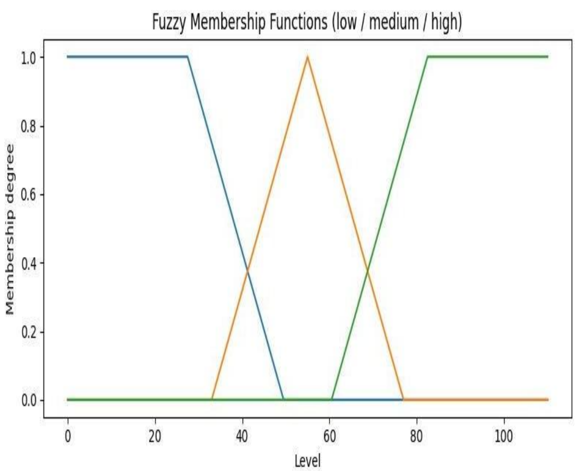

Fig. 2. Fuzzy Membership Function

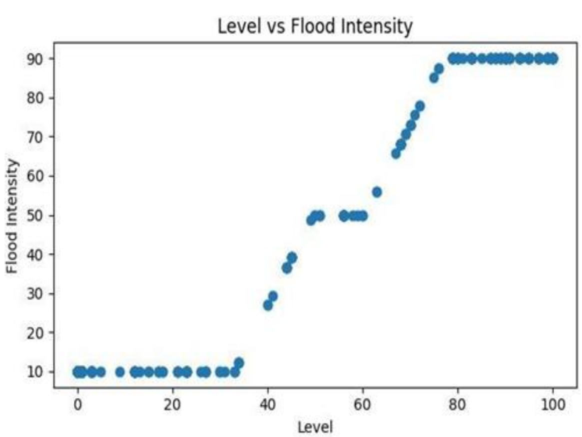

Fig. 3. Level vs Flood Intensity

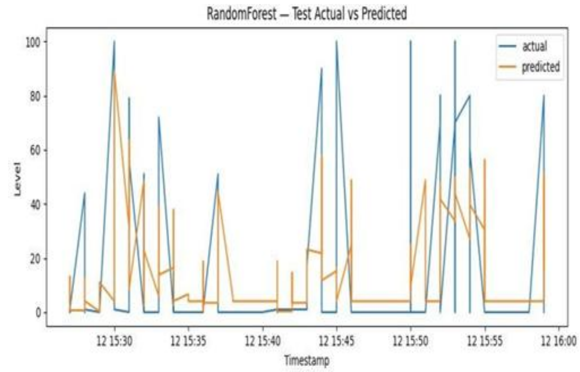

Fig. 4. Test Actual Vs Prediction

VIII. CONCLUSION

The AI Enabled Early Flood Detection and Village Alert System with LoRa and IoT manages to combine artificial intelligence with Internet of Things (IoT) and the long-range wireless communication (LoRa) to offer a reliable and real- time flood monitoring and alerting system. This system is a perfect solution to the shortcomings of the currently used cloud-reliant and GSM models due to the provision of offline, low power, and high transmission distance, which renders it the most suitable implementation in rural and remote areas. The addition of ultrasonic sensors, NodeMCU microcontrollers and LoRa SX1278 modules to the proposed architecture will allow it to constantly check the water levels and send all of the data effectively to a distance of a few kilometers without the need of an internet connection.

Improving the intelligence of the system, the AI-based predictive module is applied based on the machine learning algorithms, including the Random Forest and LSTM, which predict the possible flood risk and anticipate it before it occurs. Such a predictive power allows an early evacuation plan and mitigation of disasters, changing the paradigm of immediately alerted response to actively prevented. The outcomes of the hardware testing proved that the measurements of the water levels are highly accurate and can be trusted to transmit the data in different environmental conditions. The alert system of the system has LED displays, buzzer alarms, and LCD displays, which are easy to understand and provide instantaneous notifications to the local residents, thereby guaranteeing quick response. The scalable and modular design makes it possible to integrate with cloud platforms in the future to have centralized data analysis, government surveillance, and large-scale flood management initiatives. In general, the suggested system is a cost-efficient, energy-efficient, and intelligent way of detecting early floods and sending an alert to the village population. Integrating AI prediction, IoT sensing, and LoRa communication, it will increase the preparedness of communities, decrease the response time, and decrease the loss of life and property in case of flood disasters. The improvement of this solution the next time could be more environmental sensors (rainfall, humidity, soil moisture, and others), edge- based processing of the AI instead of the slower full prediction, and integration with a mobile application to achieve a longer period of availability. The project will provide a firm groundwork to develop intelligent, AI-based disaster management systems that will revolutionize the way rural areas will act to counter natural disasters and remain safe, sustainable, and resilient.

REFRENCE

[1] Sai, S., Kumar, P., and Reddy, A., Flood Prediction System based on IoT and LoRa Technologies, Proc. Int. Conf. Smart Computing and Communication (ICSCC), 2021, pp. 120-126.

[2] Dragulinescu, A. M., Drumea, A., and Stanescu, D. “Smart Neighbourhood: LoRa-Based Emergency Management and Environmental Monitoring Collaborative IoT Platform, Proc. IEEE Int. Conf. Emerging Technologies (ICET), 2019, pp. 55-62.

[3] Babu, R. M., and R. Rajan, "Flood and Earthquake Detection and Rescue with the IoT Technology," Proc. IEEE Int. Conf. Communication and Signal Processing (ICCSP), 2019, pp. 540-545.

[4] IOT –Base Flood Monitoring System based on the machine learning approach, Loong, C. W., Tan, J. K., and Lee, IEEE Access, vol. 11, pp. 15622-15631, 2023.

[5] Yassin, M., Rahman, M. S., and Noor, N. M., LoRa-Based Real-Time Flood Detection and Monitoring System: A Brunei Darussalam based study, Proc. IEEE Region 10 Conf. (TENCON), 2021, pp. 820826.

[6] Khuen, S. E., and Zourmand, A., Fuzzy Logic-Based Flood Detection System Using LoRa Technology, Proc. Int. Conf. Intelligent and Advanced Systems (ICIAS), 2020, pp. 310-316.

[7] Flood Forecasting System on water monitoring based on IoT-Machine Learning, Ramya, K., Praveen, T., and Aravind, B., Proc. IEEE Int. Conf. Computational Intelligence and Data Science (ICCIDS), 2025, pp. 220-227.

[8] Smart Water Quality Monitoring and Metering by using LoRa in Smart Villages: Manoharan, S., and Rathinasabapathy, 2018, pp. 380-385, Proc. IEEE Int. Conf. Smart Technologies for Smart Nation (SmartTechCon).

[9] Capineri, C., Bracciale, L., and Barsocchi, P., Sensors (MDPI), vol. 20, no. 10, pp. 1-15, 2020.

[10] Rosmiati, R., Rizal, M., and Syafrial, D., Data Communication Using LoRa Module of information transmission of Flood, Proc. IEEE Int. Conf. Information and Communication Technology (ICoICT), 2021, pp. 450-456.

[11] Rapid Flood Warning System in Recreational Areas on LoRa-Based Sensor Network, Abd Halim, N., Faiz, M. N., and Hussin, N., Proc. IEEE Int. Conf. Smart Instrumentation, Measurement and Applications (ICSIMA), 2024, pp. 210- 217.

[12] Ramdansyah, A., Yusof, A. N., and Fikri, A., “Design of LoRa-Based River and Reservoir Water-Level Monitoring System with Firebase," Proc. IEEE Int. Conf. IoT Applications and Engineering (ICIAE), 2023, pp. 160-167.

[13] Amanda, R., Setiawan, D., & Hanifa, A., Early Flood Detection Technology Using Heltec WiFi LoRa 32 V2. Proc. IEEE Int. Conf. Internet of Things (iThings), 2023, pp. 75-82.

[14] Flood Prediction and Early Warning System Using IoT in Gautam, S., and Gurung, S., Proc. IEEE Int. Conf. Emerging Smart Computing and Informatics (ESCI), 2021, pp. 510-516.

[15] Mahmud, N., Rahman, A., and Yusof, N., IoT-Based River water level monitoring system with the LoRa technology, Proc. IEEE Int. Conf. Smart Cities and Innovative Systems (ICSCIS), 2022, p. 340-347.

[16] Loong, C. W., Tan, J. K., and Lee, K. M., machine-learn based flood forecasting with IoT sensors, Proc. IEEE Int. Conf. Data Science and

Communication (ICDSC), 2023, pp. 230- 237.
[17] Khuen, S. E., and Zourmand, A., Fuzzy-Logic-Based Flood Detection System through LoRa Technology Proc. IEEE Int. Conf. Intelligent Systems and Networks (ISN), 2020, p. 180-186.
[18] Flood Forecasting System Flood Forecasting System Based on Water Monitoring Using IoT-Machine Learning, Ramya, K., Praveen, T., and Aravind, B, Proc. IEEE Int. Conf. Computational Intelligence and Data Science (ICCIDS), 2025, pp. 220-227.
[19] Image denoising by attention U-Net based network module to automate low light image enhancement, C. D. Vaidya, A. Jayavel and P. K. Mishra, Signal, Image and Video Processing (SIViP), vol. 19, p. 472, 2025, doi: 10.1007/s11760-025-04004-y.
[20] C. Vaidya, P. Shelar, J. Ukey, T. Kawale, C. Bawankar, M. Diwate, and K. Bhure, Flood prediction using machine learning, AIP Conference Proceedings, vol. 2753, no. 1, p. 030001, Apr. 2023. doi: 10.1063/5.0127968.
[21] C. Vaidya, A. Nampalliwar, K. Nampalliwar, R. Thakkar, and S. Bhagat, Statistical approach load distribution in decentralized cloud computing, Helix, vol. 8, no. 5, pp. 3532- 3536, 2018.
[22] P. K. Patel, C. Vaidya, P. Dhote, Advances and applications in mathematical sciences, Advances and Applications in Mathematical Sciences vol. 20 no. - pp. 203- 210, Dec.2020.