

Flood Monitoring and Alert System Using IOT

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Abstract - By utilizing the Internet of Things (IoT) technology, our proposed flood monitoring and early warning system aims to address the limitations of conventional methods in reaching a wider community and providing timely information about impending disasters. Traditional systems often suffer from delays in information dissemination, hindering effective disaster response. In contrast, our system leverages IoT capabilities to enable real-time data transmission from sensors to smartphones, ensuring swift and widespread alerts. The core component of our system is the monitoring of water characteristics, particularly the water level in rivers, which is crucial for predicting and assessing flood events. Sensor data on water levels is collected in real time and transmitted to a centralized database for processing and analysis. Additionally, the collected data serves as the foundation for developing an ARIMA model, which utilizes historical patterns and trends to forecast future flood events. This predictive modeling capability enhances the system's ability to provide early warnings and enables proactive disaster management strategies. The integration of IoT technology and the ARIMA model allows for more accurate and timely flood warnings, empowering authorities to take necessary actions, such as issuing evacuation alerts and allocating resources effectively. By minimizing the impact of floods through proactive measures, our system aims to safeguard lives and infrastructure. The cost-effective nature of our solution, combined with its ability to reach a wide area through internet connectivity, makes it suitable for both developed and developing regions facing the challenges of flood management.

Key Words: Flood monitoring and alert system, Internet of things, Sensors, NodeMCU

1. INTRODUCTION

Floods are natural disasters that occur when water overflows from rivers, lakes, or due to heavy rainfall. They pose significant risks to human lives, infrastructure, and the environment. The frequency and intensity of floods have been increasing in recent years, mainly due to the effects of climate change. As global temperatures rise, extreme weather events become more frequent, resulting in heavy rainfall and rising sea levels. These climatic changes exacerbate the vulnerability of communities to flooding. Timely and accurate monitoring of flood conditions is crucial for effective disaster management and the protection of vulnerable populations.

Traditional flood monitoring systems face limitations in terms of coverage, real-time data collection, and early warning

capabilities. Reliance on manual observations often leads to delayed response and increased vulnerability. Climate change further complicates the situation by introducing new patterns and intensities of rainfall, making it essential to upgrade existing flood monitoring systems. Therefore, there is a pressing need for advanced technologies that can enhance flood monitoring and early warning systems. By leveraging emerging technologies such as the Internet of Things (IoT), we can revolutionize flood monitoring and improve the accuracy of early warning systems.

In this proposed model, we focus on developing an IoT-based flood monitoring and alert system that specifically monitors the water level in rivers. By closely monitoring this crucial parameter, we can predict flood events and take proactive measures to minimize the resulting damage. The system utilizes intelligent sensors and cost-effective methods to collect real-time data on water levels, temperature, humidity, and other environmental factors. These data points are then transmitted to a central hub or cloud-based platform for analysis and decision-making. The integration of IoT technologies enhances the efficiency and accuracy of flood monitoring, allowing for timely alerts and effective response strategies.

2. LITERATURE SURVEY

The main focus of this literature survey is to explore existing models and systems developed for flood monitoring and prediction, particularly in the context of developing and underdeveloped countries. Several relevant works have been considered for this survey, as outlined below:

Simran Chau et al. [1] presented a review on flood monitoring and prediction using Wireless Sensor Networks (WSN). Their work focuses on the design of a flood observatory system that utilizes ultrasonic and water level sensors to detect increases in water levels beyond the normal capacity.

Manisha Devnani et al. [2] proposed a flood prediction and alerting system using IoT and machine learning. Their study emphasizes the integration of IoT devices and machine learning algorithms to accurately predict and alert about potential flood events.

S. Vandana et al. [3] introduced a flood alert system based on IoT. Their work explores the monitoring of rising water levels and issuing alerts through GSM technology to ensure timely warnings and evacuation measures.

MFM Fairuz et al. [4] developed a real-time flood monitoring system using Raspberry Pi. Their study focuses on the implementation of measuring sensors to detect and monitor flood situations in real-time.

B. Pallavi C [5] proposed the development of a flood monitoring system using Wireless Sensor Networks (WSN) and IoT based on cloud technology. The work highlights the utilization of cloud platforms for data management and analysis in flood monitoring systems.

Abhijeet A Pasi et al. [6] proposed a flood detection system utilizing Wireless Sensor Networks (WSN) for accurate monitoring and early detection of flood events.

3. OBJECTIVE

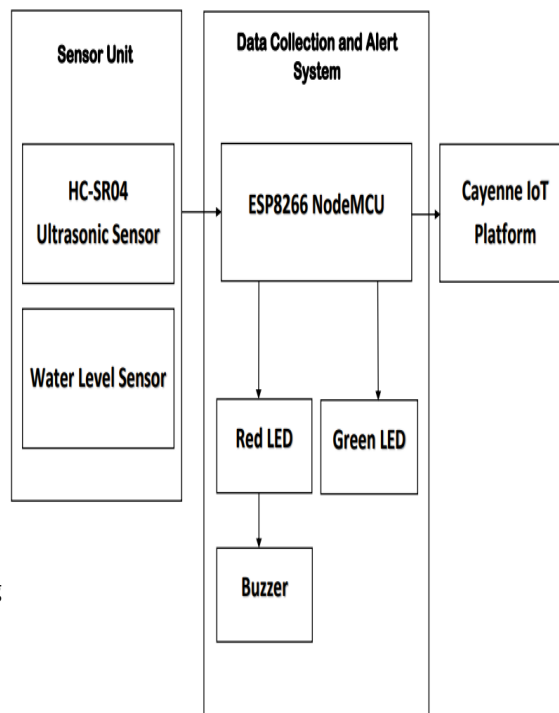
The objective of the Flood Monitoring and Alert System using IoT is to detect water levels in real-time, trigger alerts when the water level exceeds a threshold, and provide early warning to residents and authorities to prevent flood damage.

4. PROPOSED SYSTEM

The proposed Flood Monitoring and Alert System using IoT is a comprehensive solution for flood monitoring, early warning, and prediction. The system utilizes a combination of ultrasonic and water level sensors to accurately detect changes in water levels and transmit the data to the Cayenne IoT platform for analysis. When the water level exceeds a certain threshold, alerts are sent to the concerned authorities and the public via email. Additionally, the system is equipped with a red LED and a buzzer that activate as visual and auditory warnings when the water level surpasses the threshold. The system also incorporates an ARIMA-based flood prediction model that utilizes the collected data to forecast future water levels, enabling proactive measures to mitigate the impact of flooding. This model showcases the potential of IoT and machine learning technologies in addressing real-world challenges and contributing to the safety and well-being of people.

4.1 ARCHITECTURE

The proposed architecture of the Flood Monitoring and Alert System using IoT incorporates ultrasonic and water level sensors, NodeMCU for data transmission, the Cayenne IoT platform for data analysis, and an ARIMA-based flood prediction model, providing a comprehensive solution for real-time monitoring, early warning, and prediction of flood events. The architecture of the proposed system for flood monitoring is shown in Fig. 1.



Fig

-1:

Proposed system for flood monitoring

4.2 HARDWARE AND SOFTWARE REQUIREMENTS

The hardware requirements involved in the system are mentioned below:

➤ **NodeMCU**

The NodeMCU is an open-source microcontroller based on the ESP8266 Wi-Fi module. It acts as the main controller in the system, interfacing with the sensors and facilitating the transmission of data to the Cayenne IoT platform. The NodeMCU is programmed to read data from the sensors and send it to the platform for analysis.

➤ **Ultrasonic Sensor**

The ultrasonic sensor is a device utilized to measure the distance between the sensor and the water surface. It emits ultrasonic waves and measures the time it takes for the waves to bounce back after hitting the water surface. This data is used to calculate the distance and determine the water level.

➤ **Water level Sensor**

The water level sensor is designed to detect changes in the water level of the river or water body being monitored. It provides accurate readings of the water level, allowing the system to assess the current condition.

➤ **Light Emitting Diode**

LED (Light Emitting Diode) is a semiconductor device that emits light when a current is passed through it. LEDs are widely used in various applications, including as visual indicators in electronic devices, lighting, and displays.

➤ **Buzzer**

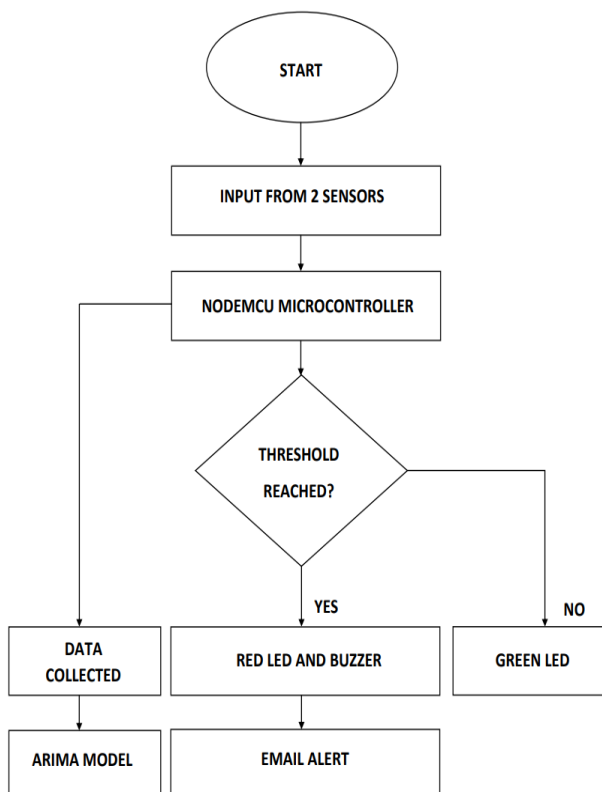
A buzzer is an audio signaling device that produces a continuous or intermittent sound when an electrical current is passed through it. It typically consists of an electromechanical component that vibrates or oscillates, generating the sound. Buzzer is commonly used in alarm systems, timers, and other applications where an audible alert or notification is required.

The software requirements for the proposed system design include the Arduino IDE, which is used for programming the microcontroller using the Embedded C language. The Arduino IDE serves as an integrated development environment for writing and uploading code to the NodeMCU microcontroller, which is an open platform compatible with ESP modules. The sensors connected to the microcontroller continuously monitor and detect the flood conditions, and the programmed logic triggers warning alerts to notify the surrounding areas.

4.3 FLOW DIAGRAM

The flow diagram related to this research work is shown in Fig. 2.

Fig -2: Flowchart

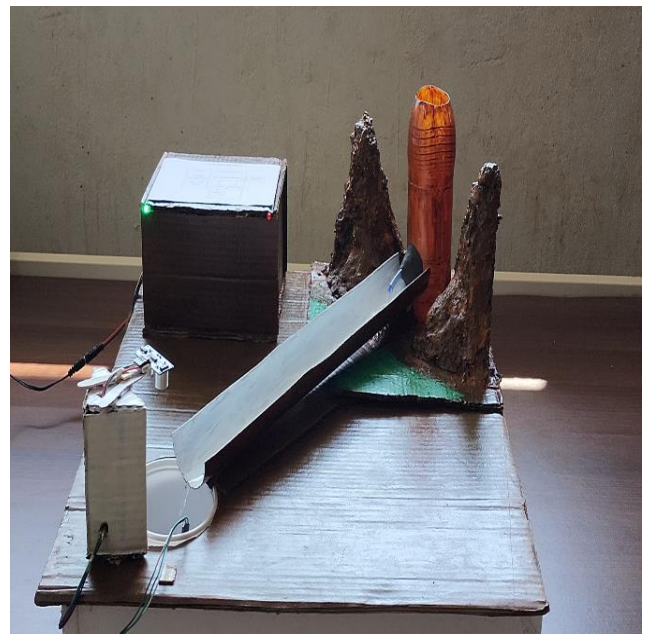


5. RESULT

The output for the flood monitoring and alert system using IoT is as follows

- In a normal situation where the water level is below the given threshold, the green LED is illuminated, indicating a normal condition. This indicates that there is no immediate risk of flooding. The proposed system, as depicted in Fig. 3, operates in a normal condition when the water level is below the threshold.

Fig -3: Proposed System Normal Condition



- When the water level rises beyond the predetermined threshold, the system enters an alert condition as shown in Fig. 4. This is indicated by the red LED glowing and the buzzer being activated to provide an audible alert.

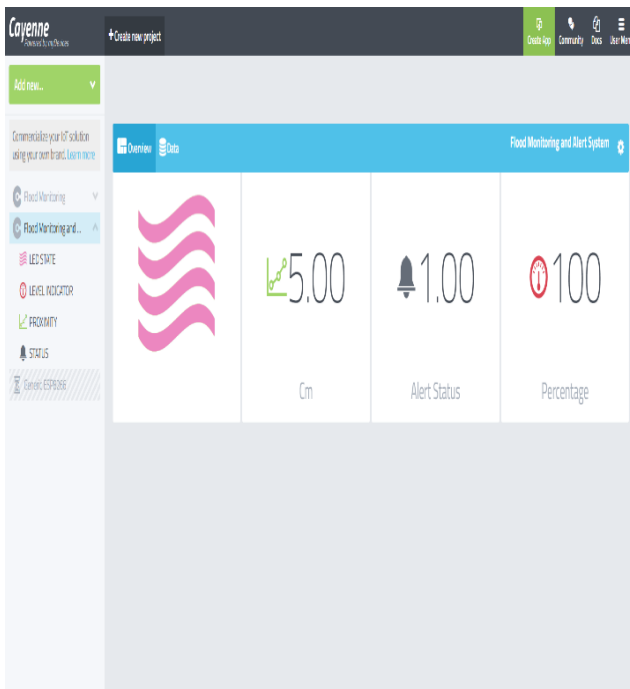
Fig -4: Water level reaches or exceeds the predefined



threshold

Upon receiving real-time data from the sensors, as shown in Fig. 5, the Cayenne platform continuously monitors the water level. When the water level surpasses the predefined threshold, the Cayenne platform promptly updates its alert status to 1, signifying an impending critical level. This proactive monitoring system ensures timely alerts to the appropriate authorities or individuals, enabling swift action to mitigate the potential risks associated with the rising water level.

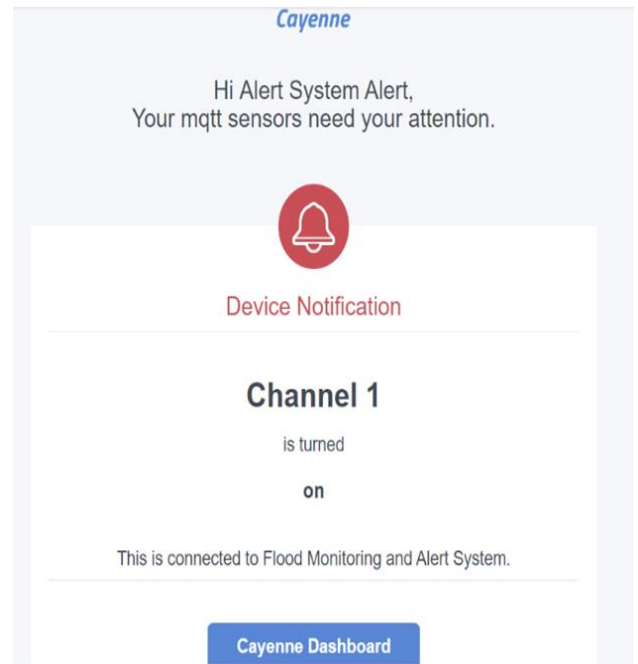
Fig -5: Cayenne dashboard alert condition



➤ The next output shows that when the water level reaches the predetermined threshold, a trigger is activated within the system. This trigger initiates the process of sending an email to the authorities, notifying them of the critical flood situation. At the same time, a quick warning message is dispatched to the residents, providing them with timely information about the impending flood and advising them to take necessary precautions or evacuate if required. This comprehensive approach ensures that both the authorities and the residents are promptly and effectively informed about the escalating flood situation, facilitating appropriate actions to be taken to ensure safety.

The screenshot shown in Fig. 6 demonstrates that an email alert is being sent to the authorities when the water level reaches or exceeds a given threshold, which may cause a flood. This alert serves to help them take necessary precautions.

Fig -6: Alert notification conveyed via email



➤ The collected data from the water level sensors is stored and used to develop an ARIMA model. This model utilizes historical water level data to predict future flood events. By analyzing the patterns and trends in the data, the ARIMA model can provide insights into the likelihood and severity of future floods. This information is valuable for proactive planning and preparedness, allowing authorities to take preemptive measures to minimize the impact of floods.

The screenshot presented in Fig. 7 provides a visual representation of the ARIMA model in action within the flood monitoring and alert system. It demonstrates how the ARIMA model utilizes the collected data of water levels from sensors to make predictions about future flood events.

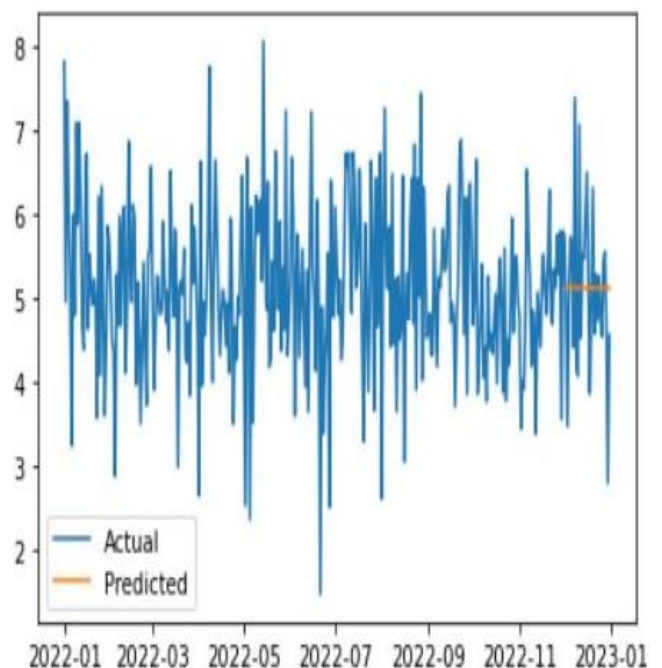


Fig -7: Flood prediction model

3. CONCLUSION

The flood monitoring and alert system using IoT presented in this study offers an effective and cost-effective solution for real-time flood monitoring and timely detection. By integrating sensors, a microcontroller, and the Cayenne IoT platform, the system accurately measures water levels and triggers alerts when the threshold is exceeded. The inclusion of a flood prediction model using ARIMA enhances the system's capabilities for future flood risk assessment. The successful implementation of this system highlights the potential of IoT and machine learning technologies in addressing critical challenges in flood monitoring. As a future scope, further enhancements can be explored, such as the integration of additional sensors for comprehensive monitoring and the use of advanced machine learning algorithms for more accurate predictions. Overall, this research presents a valuable contribution to the field of IoT-based flood monitoring systems, providing a cost-effective solution that can significantly contribute to disaster management efforts and help safeguard lives and minimize damage caused by floods.

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