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Smart IOT Based Flood Detection and Alerting System Using Decision Tree Algorithm

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A B S T R A C T

Flooding can occur in any water system when there is an excess amount of water, leading to rivers or lakes overflowing. Several factors contribute to flooding, such as heavy rainfall or dam breaches. When a dam ruptures, it releases a large volume of water rapidly, causing nearby riverbanks and surrounding areas to flood. This can result in significant loss of life and property. Flood monitoring and alert systems are vital in tracking and reducing the damage caused by such events.When a dam breaks, for example, the sudden release of water can quickly infiltrate the soil, leading to widespread flooding. Rivers and their banks are particularly vulnerable, and this can disrupt local stations and communities. In addition to destroying homes and businesses, floodwaters often carry harmful bacteria, sewage, and hazardous chemicals, which can lead to the spread of diseases.For accurate flood predictions, essential data such as the real-time changes in river stages are crucial. This information helps assess the severity and urgency of the flood threat. In this system, we use an ESP32-WROOM microcontroller along with water and rain sensors to predict floods. These sensors gather data and transmit it via the Internet of Things (IoT). Upon detecting flood conditions, the system calculates how long it would take for flooding to reach a particular area and sends alerts to the affected villages or regions, while also sounding alarms to warn residents about the impending danger. This system aims to reduce the impact of floods by providing timely warnings to authorities and nearby communities.

Keywords: Flood detections, ESP32-WROOM, Rain sensor, Transmit information, Alert, IOT.

INTRODUCTION

Flooding is one of the most destructive natural disasters, resulting in significant damage to lives, property, and infrastructure. It can be triggered by several factors, including heavy rainfall, dam failures, and the overflow of rivers and lakes. When a dam breaks, it releases a large volume of water, quickly flooding nearby areas and riverbanks. The excess water can seep into the soil, causing further structural damage and environmental risks. In addition to the physical destruction, floodwaters often carry dangerous contaminants such as bacteria, sewage, and chemicals, leading to serious health concerns and the spread of diseases.With floods becoming more frequent and severe, there is an urgent need for advanced monitoring and alert systems to minimize these impacts and safeguard communities. The IoT-based flood monitoring and alert system is designed to meet this need by providing real-time data on water levels and rainfall. Using an ESP32-WROOM microcontroller and various sensors, the system predicts potential flooding and sends immediate alerts to authorities and affected communities. This proactive approach helps improve disaster preparedness and response, ultimately reducing the loss of life and property.

PROBLEM STATEMENT

The primary goals include the design and deployment of a reliable sensor network, the development of a real-time data processing and decision-making unit, and the creation of a dependable notification system. Specifically, we aim to establish a network of sensor nodes to monitor key environmental parameters, transmit the data to a central processing unit, and utilize a trained decision tree algorithm to predict flood events. A key objective is to optimize this algorithm for real-time performance, ensuring that flood alerts are generated quickly and accurately. The system's design, implementation, and evaluation results will offer valuable insights and recommendations for future improvements and potential advancements in this essential flood mitigation technology.

LITERATURE SURVEY

Hadi, M. I., Yakub, F., Fakhrurradzi, A., Hui, C. X., Najiha, A., Fakharulrazi, N. A., ... & Azizan, A. (2020, June). Designing early warning flood detection and monitoring system via IoT. In *IOP Conference Series: Earth and Environmental Science* (Vol. 479, No. 1, p. 012016). IOP Publishing. Flooding is one of the biggest natural disasters that occurs frequently around the world. It can occur without warning and the after effect of it leaves great

damage to the surrounding environment and exposes life threatening to citizen. Therefore, early flood detection and monitoring system with the implementation of Internet of Things and Global Positioning System is proposed in order to reduce the risks that may cause flooding. The aim of this project is to provide the information of a current water level in a drain. When water level increases to a certain level, the system will send a warning notification to users indicating three categories of water level, which are safe, warning and critical level. This system contains an ultrasonic sensor to detect the current water level and at the same time allows users to observe the period of the water level from their phone so that users are more aware of when flooding ought to happen. Moreover, the system consists of a flooding avoidance method that requires the usage of a solenoid as a shutter valve of the drain and water pump to pump out excessive water flow to a suitable place for water release purposes.

BLOCK DIAGRAM

Figure 1 showcases the different interfacing circuits used in this project, which include the ESP32-WROOM, motor driver, rain sensor, DHT11 sensors, ultrasonic sensors, LCD display, water flow sensor, camera module, buzzer, and LED light indicator. The system begins by collecting data from various sensors, such as water level, rainfall, and weather stations. This data is then transmitted to the cloud/server via an IoT gateway. The decision tree algorithm processes the sensor data and makes predictions about the likelihood and severity of flooding based on predefined rules. This system offers an efficient and accurate method for detecting floods and notifying stakeholders in real-time, thereby helping to minimize losses and enhance public safety.

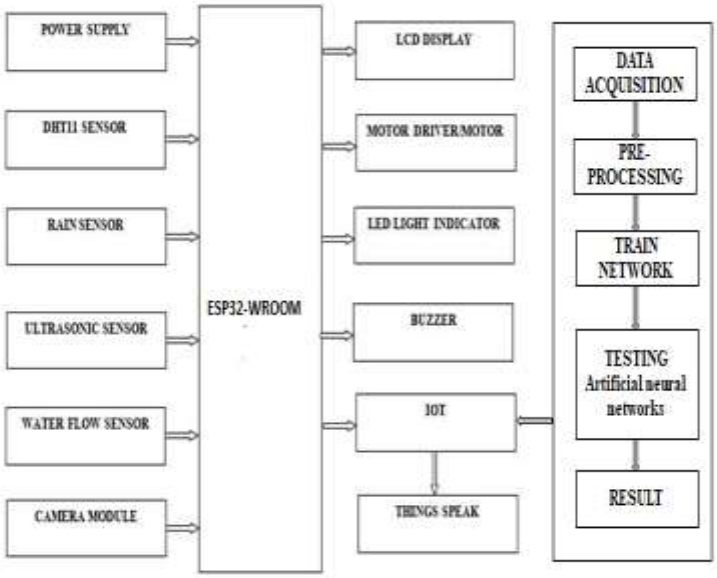


Figure 1: Block Diagram of IOT Based Flood Detection and Alerting System Using Decision Tree Algorithm

SIMULATION DIAGRAM

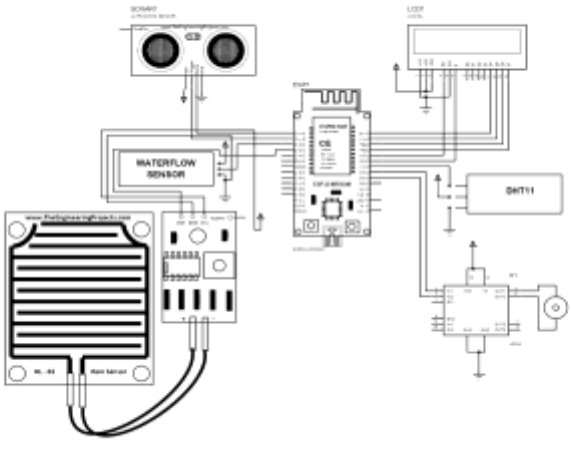


Figure 2: Simulation Diagram

The circuit diagram depicts a system likely designed for environmental monitoring or automation, centered around an ESP8266 microcontroller (labeled ESP8266 NODE MCU). This microcontroller acts as the brain, processing data from various sensors and controlling output devices.On the left side, we see a rain sensor (HC-83) and a water flow sensor, both providing input to the ESP8266. The rain sensor likely measures precipitation, while the water flow sensor measures the rate of liquid flow. Above the water flow sensor is a SONAR (likely an ultrasonic distance sensor), labeled SONAR1, which would provide distance measurements.On the right side, the diagram shows output devices. An LCD1 (likely a 16x2 character LCD) is connected to the ESP8266 for displaying information. A DHT11 sensor, which measures temperature and humidity, is also connected.The bottom right corner shows a relay module (labeled U1), likely an L298N, controlling a motor (labeled MOTOR). This suggests the system might be capable of actuating a physical device based on the sensor readings, perhaps opening or closing a valve or triggering an alarm.The diagram also indicates the presence of a 5V regulator (labeled LM7805), suggesting the system requires a stable 5V power supply for some of its components.Overall, this circuit diagram represents a system designed to collect environmental data and control a device based on that data, likely for applications like weather monitoring, irrigation control, or automated systems.

HARDWARE

The IoT-based flood monitoring and alert system continuously collects and analyzes environmental data to predict and mitigate flood risks. It utilizes the ESP32-WROOM microcontroller to interface with sensors, process data, and transmit alerts via IoT networks. Water level sensors monitor rising water levels in rivers, lakes, or reservoirs, while rain sensors measure rainfall intensity and duration. The system employs predefined thresholds and algorithms to evaluate flood likelihood. If water levels surpass safe limits, it assesses the urgency and severity of the situation. Upon detecting a potential flood, a buzzer is activated for local audible alerts, while IoT platforms transmit notifications to authorities and residents in vulnerable areas. By analyzing water level trends and rainfall patterns, the system estimates the time before flooding reaches critical zones, enabling timely evacuation warnings.

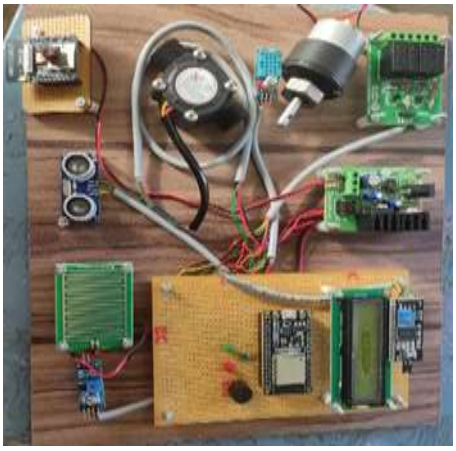
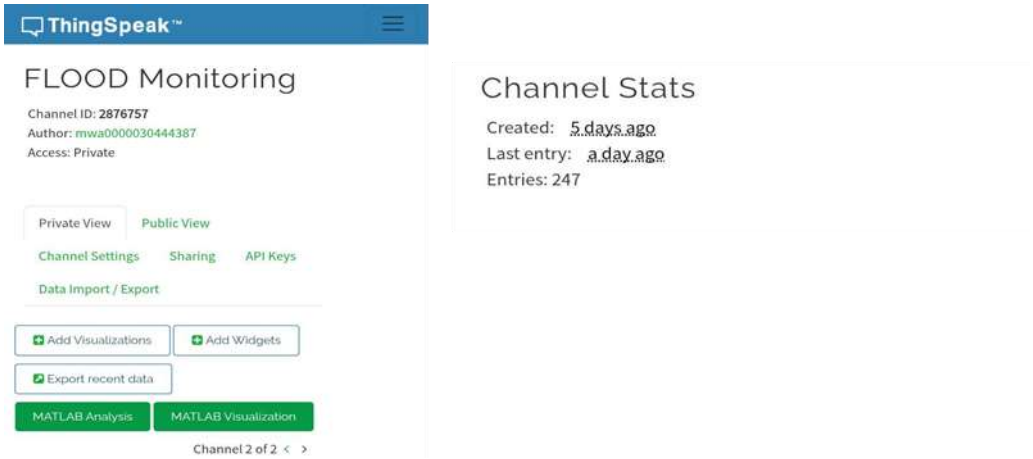
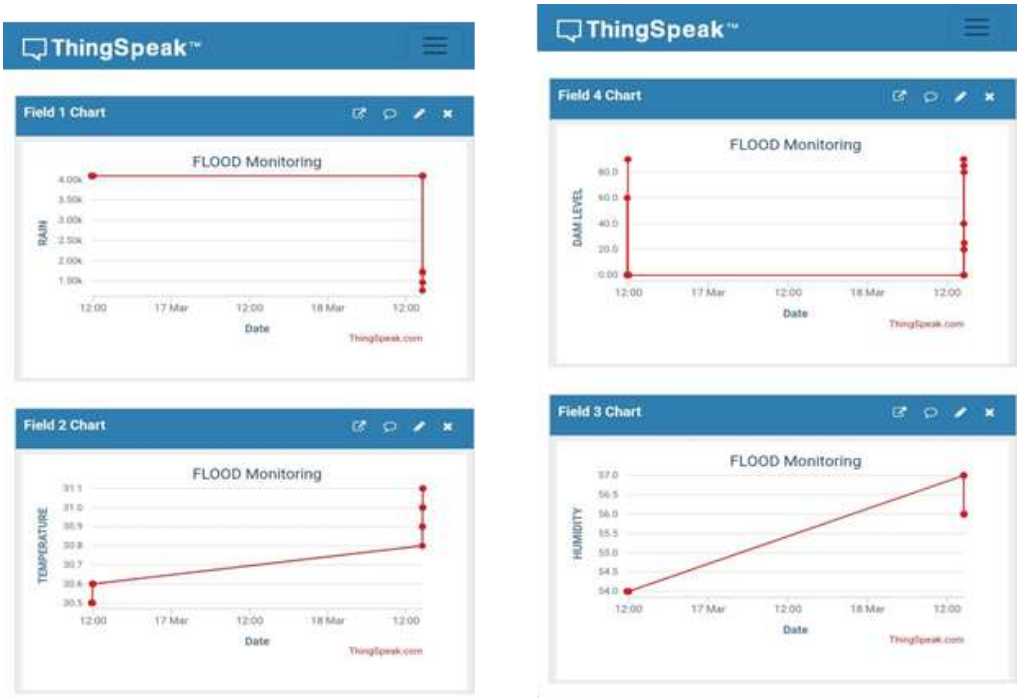


Figure 3: Hardware of IOT Based Flood Detection and Alerting System Using Decision Tree Algorithm

OUTPUT





ThingSpeak charts provide a real-time visualization of rainfall, dam level, humidity and temperature data, allowing users to monitor potential flood risks in Chennai. The sudden increase in both rainfall and temperature at the end of the period suggests a significant weather event, potentially indicating heavy rainfall and a rapid rise in temperature that could contribute to flooding. The ThingSpeak platform effectively presents this data for timely analysis and response.

CONCLUSION

The IoT-based flood monitoring and alert system utilizing the ESP32 microcontroller offers an efficient and reliable solution for early flood detection and disaster prevention. By continuously tracking water levels and rainfall intensity, the system can predict potential flood conditions and issue timely alerts to authorities and residents.IoT integration enables real-time data collection, remote monitoring, and rapid alert transmission, enhancing the response to flood threats. Its automated operation and predictive capabilities ensure early warnings, minimizing loss of life, property damage, and infrastructure destruction.Scalable and cost-effective, the system can be deployed across multiple flood-prone regions, providing a proactive approach to flood management. Future enhancements, such as machine learning algorithms for more accurate predictions and additional environmental sensors, can further strengthen disaster preparedness and public safety.In summary, the IoT-based flood monitoring and alert system plays a crucial role in mitigating flood impacts by delivering real-time monitoring and early warnings, ultimately improving community resilience and disaster management efficiency.

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