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Artificially Intelligent Flood Early Warning System Using Wireless Network

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ABSTRACT

Floods are a major threat to both human life and infrastructure, making early detection and warning systems essential. This project introduces an IoT-based Flood Detection and Warning System powered by a PICO microcontroller, integrated with various sensors such as a sound sensor, IR sensor, vibration sensor, and soil moisture sensor. These sensors continuously monitor environmental factors like water level, ground vibrations, and soil moisture to identify potential flood situations. When sensor readings exceed predefined limits, the system processes the real-time data and activates alerts using LEDs and a buzzer. Through IoT connectivity, the system allows for remote monitoring and timely notifications, enabling quick preventive actions. This automated, low-cost solution improves disaster response and significantly reduces the risks associated with flooding.

INTRODUCTION

Floods rank among the most destructive natural disasters, often leading to severe loss of life, damage to property, and disruption of infrastructure. To minimize these impacts, early detection and timely warning systems are essential. Traditional flood monitoring approaches, which depend on manual observation and weather forecasts, often fall short during rapidly evolving weather conditions. This project introduces an IoT-based Flood Detection and Warning System designed to detect flood risks in real time. It employs a combination of sensors—including a sound sensor, IR sensor, vibration sensor, and soil moisture sensor—to monitor environmental indicators associated with flooding. A PICO microcontroller processes the collected data and activates alert mechanisms such as LEDs and a buzzer when critical thresholds are crossed. With the integration of IoT technology, the system offers continuous real-time monitoring, remote access to flood data, and automated alerts. This makes it a cost-effective, reliable, and scalable solution for enhancing disaster preparedness in flood-prone regions.

LITERATURE SURVEY

Floods are among the most destructive natural calamities, resulting in significant loss of life, infrastructure damage, and economic disruption. Traditional flood detection methods, which depend on manual monitoring and weather forecasts, often lack the ability to provide real-time alerts. The integration of Internet of Things (IoT) technology has revolutionized flood monitoring by enabling continuous data collection, real-time analysis, and remote alerting systems.

Numerous studies have explored the application of IoT in flood detection using various sensors and communication technologies. Sharma et al. (2021) demonstrated the effectiveness of IoT-based sensors in monitoring environmental parameters like water level, soil moisture, and vibrations caused by water flow—factors that help in accurately predicting flood events.

EXISTING METHOD

Flood detection and warning systems have evolved through various technologies to improve accuracy and response time. Water level monitoring systems use ultrasonic or float sensors installed in rivers, lakes, and drains to track water levels and issue alerts when thresholds are exceeded. Rainfall-based prediction systems rely on rain gauges and weather stations to measure precipitation, forecasting floods through historical rainfall patterns and hydrological models. Sensor-based flood monitoring integrates IoT-driven networks using soil moisture, vibration, IR, and sound sensors to detect early signs of flooding, triggering alerts via buzzers, LEDs, or remote notifications. Satellite and remote sensing technologies, employed by agencies like NASA and ISRO, continuously observe water bodies and land moisture to identify flood risks. AI and machine learning models combine real-time sensor input, historical data, and weather reports to forecast floods, with cloud-based systems enabling remote data analysis and improved decision-making.

PROPOSED METHOD

ChatGPT said: Floods are one of the most destructive natural disasters, posing serious threats to life, infrastructure, and the economy. To address this, an IoT-based flood detection and warning system has been developed using a NodeMCU microcontroller and multiple sensors. The system continuously monitors key environmental parameters such as water level, soil moisture, vibrations, and

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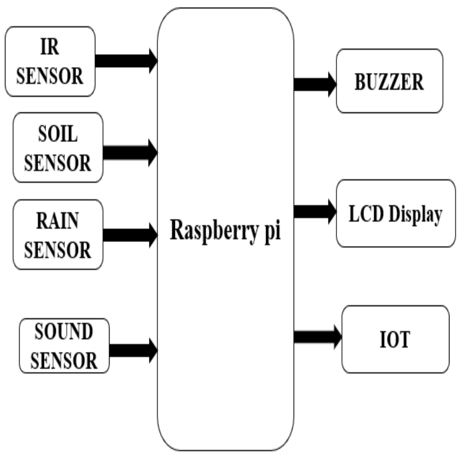
Vol 19, Issue 3, 2025

abnormal water sounds. Components like IR sensors, vibration sensors, soil moisture sensors, and sound sensors feed real-time data into the NodeMCU, which analyzes the input to detect potential flood risks. When sensor thresholds are exceeded, the system activates local alerts using buzzers and LEDs while simultaneously sending data to IoT platforms like Blynk, Firebase, or ThingSpeak. This ensures both on-site and remote flood warnings. Real-time cloud storage allows continuous monitoring and historical data tracking.

BLOCK DIAGRAM

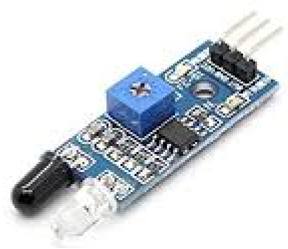


HARDWARE REQUIREMENTS

Raspberry pi

The Raspberry Pi is an affordable, compact single-board computer roughly the size of a credit card. It runs on Linux-based operating systems and supports programming languages such as Python, C, and C++. Commonly used in IoT, robotics, and AI projects, it features USB ports, HDMI output, GPIO pins, and a microSD card slot for storage. Models like the Raspberry Pi 3B+, 4, and Zero offer built-in Wi-Fi, Bluetooth, and Ethernet for networking. The GPIO pins enable easy interfacing with sensors, actuators, and displays.

IR SENSOR



The Infrared (IR) sensor is used to detect the presence of nearby objects or measure the water level. It emits infrared light and measures the reflection from a surface to determine proximity. In flood detection, the IR sensor helps in identifying rising water levels. The sensor gives a digital signal to the Raspberry Pi based on reflection strength. It is non-contact and highly reliable for distance-based detection. Useful for identifying overflow in drainage systems or riverbanks.

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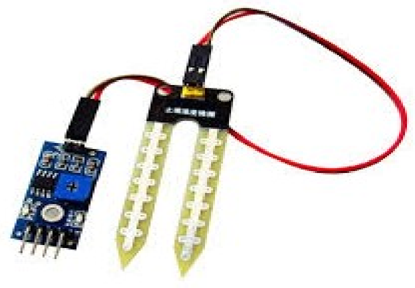
Vol 19, Issue 3, 2025

SOIL SENSOR



This sensor measures the water content present in the soil. It works on the principle of conductivity – wet soil conducts electricity better than dry soil. It outputs an analog or digital signal indicating moisture level. In flood systems, it helps determine ground saturation before flooding. It consists of two probes inserted into the soil. When the soil becomes too wet, the resistance decreases.

RAIN SENSOR

The rain sensor detects rainfall presence and intensity. It typically uses a conductive plate to sense water drops. When rain falls on the surface, the resistance changes and a signal is sent to the Pi. It helps identify the onset of heavy rainfall, which may lead to flooding. Provides both analog and digital outputs depending on design. Easy to mount on rooftops or open areas. Can trigger alerts or activate data logging when rain is detected. Useful in smart irrigation and weather monitoring as well.

SOUND SENSOR

This sensor detects sound levels in the environment. It uses a microphone to capture acoustic signals like rushing water. The sound of fast-moving water is an early indicator of flooding. It outputs analog or digital signals depending on the module. Can help detect abnormal sounds near rivers, drains, or dams.

BUZZER

The buzzer provides an audio alert in case of potential flood risk. It is triggered by the Raspberry Pi based on sensor input thresholds. Buzzers help in immediate local awareness even without internet. Can be

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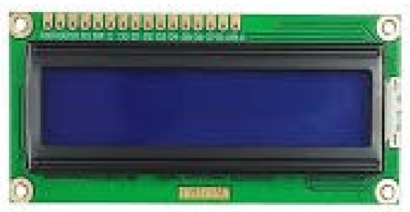
Vol 19, Issue 3, 2025

used to distinguish between levels of danger using tone or pulse.

LCD DISPLAY



The LCD display shows real-time sensor readings and flood warnings. Common models used are 16x2 or 20x4 character LCDs. Displays parameters like moisture %, water level, rainfall status, etc. Helps in debugging and system monitoring without needing a PC. Interfaced using GPIO or I2C for efficient communication. Useful for on-site viewing of sensor data by field personnel.

SOFTWARE REQUIREMENT

Arduino Software (IDE)

The Arduino IDE (Integrated Development Environment) is a user-friendly and efficient platform designed for programming Arduino boards. It supports C and C++ with simplified syntax, making it ideal for microcontroller-based applications. The IDE features a clean interface where users can easily write, compile, and upload code to their Arduino devices. It comes with a wide range of built-in libraries that simplify tasks such as sensor reading, LED control, and motor operation. The Serial Monitor enables real-time communication and debugging between the Arduino and a computer. Compatible with Windows, macOS, and Linux, it offers broad accessibility. Its Library Manager allows users to add community-developed libraries for extended functionality. Being open-source, the Arduino IDE can be modified to suit specific development needs. It is widely used in educational settings, IoT projects, and embedded systems. Its simplicity makes it perfect for beginners, while its flexibility also caters to advanced developers.

CONCLUSION

The IoT-based Flood Detection and Warning System offers an effective solution for early flood monitoring and response by combining multiple sensors with real-time data processing. It integrates sound, IR, vibration, and soil moisture sensors with a NodeMCU microcontroller to continuously

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www.ijasem.org

Vol 19, Issue 3, 2025

track environmental changes that signal potential flooding. When sensor values exceed set thresholds, the system activates immediate alerts through buzzers and LEDs, ensuring timely warnings for enhanced safety. IoT connectivity allows for remote monitoring and data access, making it a valuable tool for disaster preparedness and management. Designed to be cost-effective, scalable, and reliable, this system is well-suited for deployment in flood-prone regions. Future improvements could include cloud-based data logging, smartphone notifications, and AI-driven prediction models to further boost accuracy and responsiveness.

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