Real Time Flood Monitoring and Notification System Using IOT

Mr. CH. RAMAMOHAN[1], B. JYOTHI[2], K.NAVYASREE [3], N.VANISREE.[4], T.RAVITEJA[5],

M.PAVITHRA[6], M.CHAITHANYA[7]

[1]ASSOCIATE PROFESSOR, [2,3,4,5,6,7]STUDENT

[*1,2,3,4,5,6,7] Department of Electronics and Communication Engineering, SVIT, Anantapur, Andhra Pradesh, India.

Abstract - Floods can be very dangerous and cause serious damage to people and property.To help give early warnings,a real-time flood monitoring system can be made using IoT and the ESP32 microcontroller.This system uses different sensors like water level sensors,flow sensors,and rain gauges to collect live data from rivers,reservoirs,or areas that often flood.The ESP32 processes this data and sends it to a cloud server through Wi-Fi for analysis.The system also has an alert feature that can send warnings through SMS,email,or mobile app notifications to authorities and residents.The system also includes a simple web dashboard for remote monitoring. The use of IoT will allow for continuous data acquisition, low power monitoring, and real-time decision making. The ESP32 will act as a central processing unit to gather data from the sensors and send it to the cloud platform through Wi-Fi. Real-time data visualization will take place through a web-based dashboard or a mobile app, with access for both authorities and residents to monitor flooding remotely. A notification alerting the appropriate authorities or residents will be sent automatically via SMS when water level thresholds are reached for each water level sensor.

Keywords-ESP32, Flooding Water Level, Sensors, Early alerts, SMS alerts, Monitor.

1. INTRODUCTION

Floods can pose a threat to human life, homes, and ecosystems and are among the most devastating disasters in nature. To mitigate the impacts of flooding, this project describes a smart monitoring and alert flood monitoring and alert system that uses IoT and the ESP32 microcontroller. The monitoring system includes multiple sensors to continually monitor real-time water level readings, which then use Wi-Fi to deliver the data to a cloud platform. Once the water level reaches a predetermined safe level, the flood monitoring and alert system will automatically alert text messages, emails, and/or push notifications to inform authorities and members in the community for the potential evacuations or property protection prior to the flood. In summary, this flood monitoring system is smart, simple to use, and costs little to implement. It may be beneficial in any rural region or those vulnerable to flooding as it can save lives and property prior to a flood, with a potential early warning. Government, disaster management organizations, and/or community members could take advantage of this monitoring and alert flood monitoring system along with improving safety and research efforts in emergency preparations.

2. LITERATURE SURVEY

[1]A study by Kumar et al.(2020) Proposed an IoT-based flood monitoring system using Arduino and external Wi-Fi modules. There were limitations of real-time data transmission and efficiency of power. An IoT-based flood monitoring system uses Arduino along with a GSM module to transmit real-time flooding alerts via SMS and available on a cloud-based monitoring platform. This provided early warning to assist in disaster management, especially in remote areas where the internet is not available.

[2]Sharma et al. (2021) designed a flood alert system using GSM-based notifications. With no remote monitoring using a cloud-based platform. Recent research has examined the benefits of the ESP32 for IoT applications. This wireless flood alert system using GSM communication gives real-time flood alerts via SMS, creating a system of monitoring for flood events that can alert people to rising water levels. This is useful in remote areas with limited access to the internet.

[3] Patel et al.(2022) demonstrated the use of ESP32 in real-time environmental monitoring due to its built-in wi-

fi and bluetooth capacities that assist in the seamless electronic transfer of data.The ESP32 is a powerful and inexpensive microcontroller that was favored due to its built-in wi-fi and bluetooth for real-time environmental monitoring as it relates to monitoring the flood events. The ESP32 allows for the wireless collection and device communication.

[4] Gupta et al. (2023) implemented an Flood Monitoring System Based on ESP32 with Cloud Computing Interface.In their work, they allowed authorities and citizens to check a cloud-connected web dashboard and get mobile alerts for live flood data. Their research showed performance improvement, power savings, and multi-tasking capabilities compared to Arduino-based systems. The recommended technology used ESP32 as a microcontroller to enhance flood monitoring. Using water level sensors, rain gauges, and IoT cloud storage served to increase the efficiency of real-time flood monitoring. This technology also included a mobile notification for alerts and web access for remote monitoring while overcoming the limitations of earlier systems. Overall, this technology is considered to improve the incident preparedness and response.

3. PROPOSED METHODOLOGY

The IoT-based Flood Monitoring and Notification System utilizes a well-defined methodology, establishing an overall framework for data collection, data analysis, and notification. Several different types of sensors will form the basis of the system, including water level sensors, flow sensors, and rain gauges, that will be placed in flood-prone regions, utilized for real-time monitoring. An ESP32 microcontroller will be used to process the data collected and send it to a cloud server via Wi-Fi or LoRa connectivity. The cloud server will analyze the collected environmental data, identifying possible flooding risk using either machine learning models or predetermined thresholds.Once a possible flooding risk is identified, notifications will also be automated by the system with numerous modes of communication, including SMS, email, and mobile app notifications, ensuring timely alerts for both authorities and residents. In addition to communication, the system can provide a website-based dashboard for real-time monitoring and visualization of flood-related data that can enable emergency responders to take preventative action.Prior to deployment, the system will be tested extensively under controlled simulated flood conditions to ensure accurate and effective operation in the expected conditions. After verification, it will be installed in high-risk areas to monitor real-time flood conditions. This methodology will support an effective, low-cost, and a sustainable flood monitoring solution.

3.1 Block Diagram

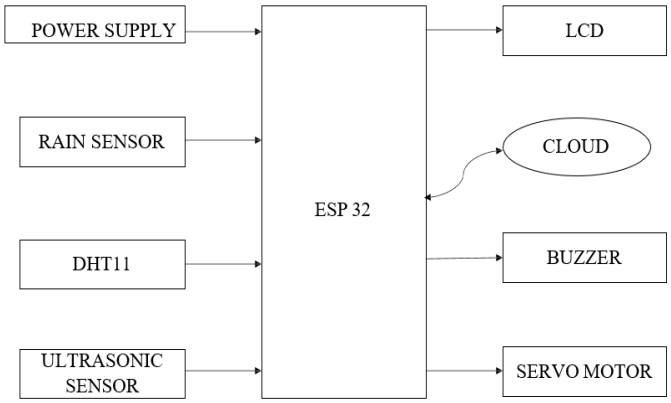

Figure 1: Block Diagram

a. ESP32 Micro-Controller

The ESP32 microcontroller acts as the main processing unit in a flood monitoring and alert system with IoT. It collects, analyzes, and sends input from several sensors connected to the microcontroller. The ESP32 is wired to water level and flow sensors, to monitor the water level of the river, reservoir, or drainage. The ESP32 has built-in Wi-Fi and Bluetooth capabilities that prepare the microcontroller to send real-time sensor data to a cloud web app or mobile application for ease of use. The ESP32 can also send alerts or notifications to app, SMS, email, when water levels are at dangerous levels. The ESP32 has low-power requirements, multiple GPIO pins, and is also compatible with IoT-related protocols like MQTT and HTTP, making them dependable for public, real-time flood monitoring application.

b. Rain Sensor

A rain sensor detects rainfall and measures its intensity by detecting water droplets on its plate. It usually consists of a conductive plate or a water-sensitive board with exposed traces. When rainwater falls on the sensor, current flows between the traces and completes the circuit, causing resistance to decrease. Then, based on the amount of water, the sensor generates an analog or digital signal. This signal is sent to the corresponding microcontroller (like ESP32) for data processing and to actuate alerts or automate actions, such as closing windows or turning on drainage systems.

c. DHT11 Sensor

The DHT11 is a digital sensor that measures temperature and humidity.It uses a thermistor to check temperature and a humidity sensor to measure moisture in the air. After the sensor gathers data, an internal chip processes the data to transmit the output reading as a digital signal to a ESP32 microcontroller. The sensor operates on a single-wire communication protocol which makes it easy to interface with microcontrollers. DHT11 is an inexpensive, low-power consumption application with easy-to-use operation commonly used in Internet of Things such as weather monitoring, smart homes, and agriculture.

d. Ultrasonic Sensor

A distance is measured by an ultrasonic sensor using sound waves. This type of sensor has a transmitter which sends out high-frequency ultrasonic pulses, and a receiver which can detect the sound waves after they have bounced off an object. The distance is calculated by measuring the amount of time it takes for the echo to return and the speed of sound in air is then used to calculate the distance. The sensor will pass this information to a microcontroller - such as an ESP32 - for processing.

e. Servo motor

A servo motor is a special type of motor that moves to a specific position when given a command. It is employed for automated control tasks, such as opening or closing floodgates dependent on water levels. The servo motor receives a control signal (PWM - Pulse Width Modulation) to accurately adjust its position. The ESP32 microcontroller sends signals to the servo motor instructing it to turn to a specific angle. A DC motor, gear system, and feedback mechanism within the servo all work together to ensure accurate positioning.

f. Buzzer

A buzzer is a small device that makes a sound when electricity passes through it.An alerting device in a flood monitoring and warning system is a buzzer that can be used to alert individuals of rising water levels. The buzzer is activated by the ESP32 microcontroller when sensor data indicates a flood risk. Upon activation, the buzzer outputs a loud alert sound that alarms individuals in the vicinity to be cautious. Thus, it is an important mechanism for allowing immediate audible warnings in an emergency setting.

3.2 System Architecture & Working Principle: The IoT flood monitoring and notification system operates by continually collecting and analyzing environmental data to identify potential flood risks. The system architecture is built upon the ESP32 microcontroller, which can connect to a variety of sensors such as an ultrasonic sensor used for measuring water levels, a rain sensor used for measuring the amount of rainfall, and a DHT11 sensor used to collect temperature and humidity. All sensors detect environmental change and send their real-time data to the ESP32 microcontroller, which processes and transmits the collected data to a cloud platform through WiFi. When the water level reaches to threshold, the system will operate an alert mechanism - this includes a buzzer that sounds to alert people in the near vicinity, and an LCD display that displays the real-time reading from the sensors. In addition, a servo motor can be activated to automatically open or close a floodgate to pace the flow of water.

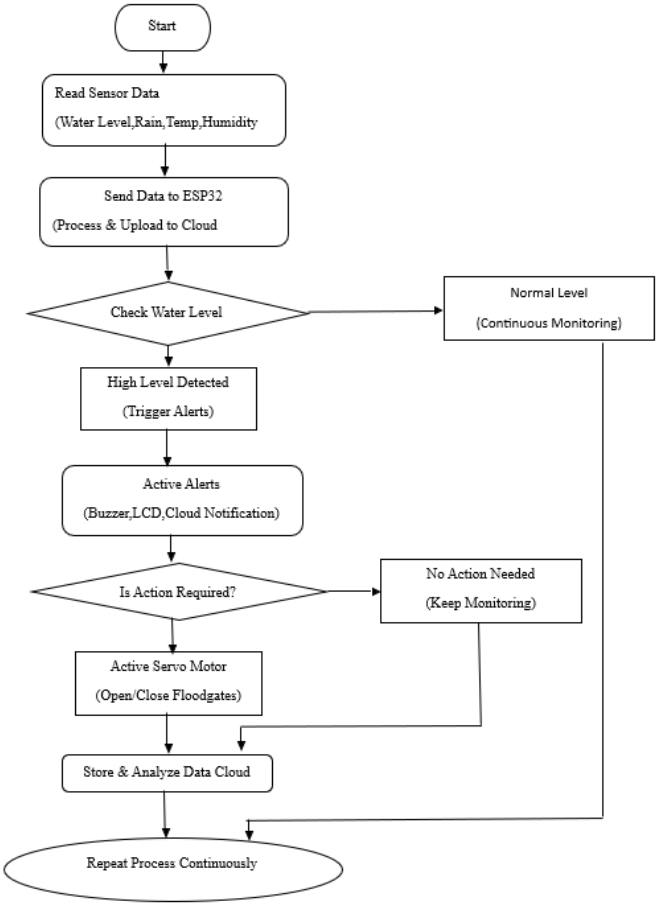

Figure 2: Flow Chart of Working of proposed system

The cloud platform is also useful in that it collects that same data, and then sends notifications to authorities or residents via SMS, email, or an app. Collectively, the system will enhance early warning and response capability with real-time monitoring, which can reduce the impacts of flooding with an efficient, automated flood

detection and response system that relates to and can incorporate IoT technology for assisting in safety and disaster preparedness.

3.3 Hardware Implementation

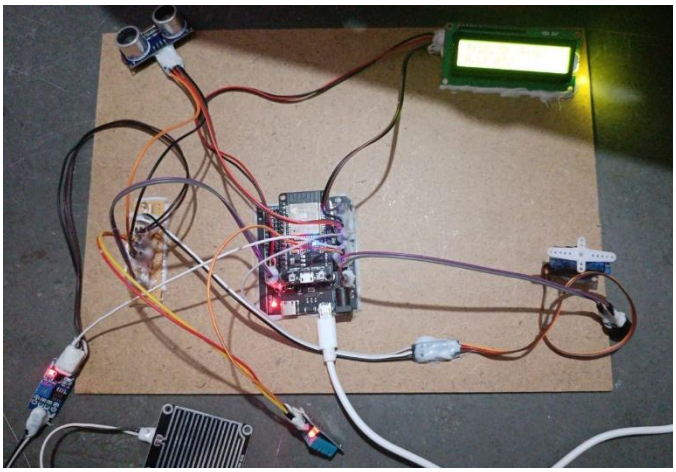

Figure 3: Physical Connection of System

The Flood Monitoring and Alert system uses an ESP32 micro controller to gather and process real-time data from several different sensors. It has an ultrasonic sensor that takes water level readings, it has a rain sensor that measures how much rain is falling, and it has a DHT11 sensor that monitors temperature & humidity. Once readings indicate that waterlevel is above a safe level, an alarm is activated and a warning message is displayed on an LCD display. The data is also sent to the cloud. In addition to notifications, there is also a servo motor that can be set up to automatically open the floodgates. All data is stored online and community members can view the data to get early warnings and take precautions to stay safe.

4. RESULTS

Since we found that this system monitors water level and humidity&temperature in the environment in real-time and it generates accurate and timely SMS alerts to registered mobile numbers when the water level reaches to threshold then the system will alert the people through buzzer or SMS.

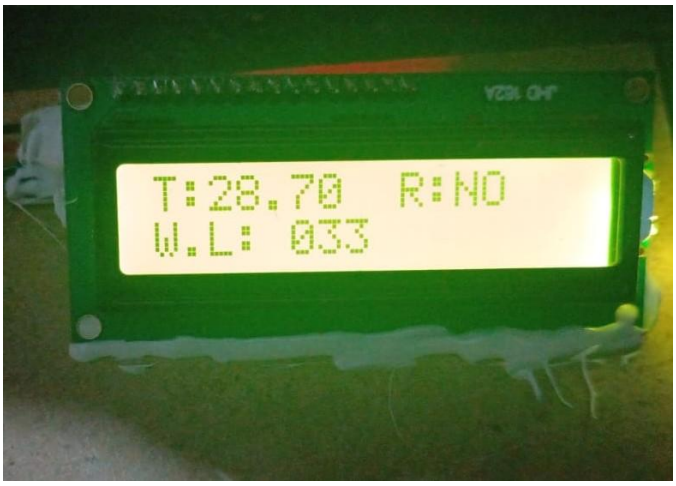

Figure 4.1:Showing Real-Time Temperatute,Rainfall and Water Level Data

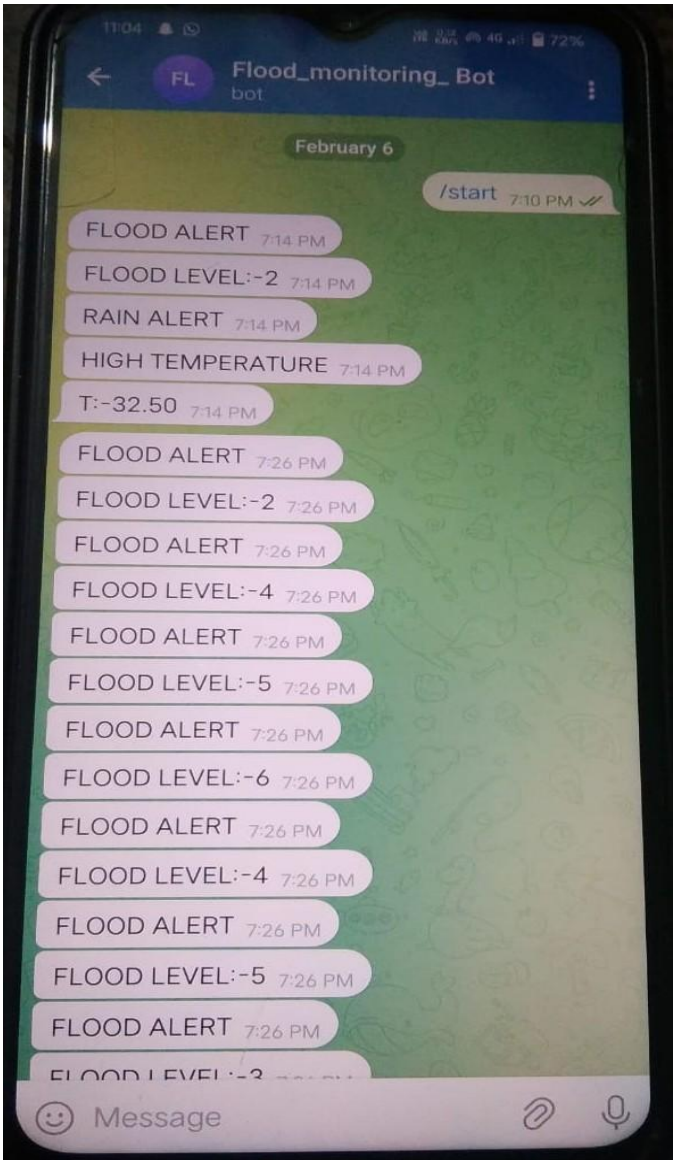

Figure 4.2: Telegram Bot Alert Messages

5. CONCLUSION

To conclude, the project is an efficient and low-budget solution for monitoring and for displacement for floods. By utilizing sensors and ESP32 microcontroller water level, rainfall, temperature, and humidity will be able to be measured and recorded in real-time. This systems sends alerts via alarms, displays and notifications to mobile devices in the cloud, general public, and citizens to mitigate response time for flood threats, in return minimizing damage and injuries and saving lives. All in all, this project is beneficial for flood safety and has potential for further developing for disaster management.

6. FUTURE SCOPE

To make improvements down the road, they could use more accurate and advanced sensors along with faster communication devices to get more precise and quicker results. Creating a mobile application would be beneficial to send alerts for flooding to people's phones directly - perhaps also by using a text message system. They could also implement solar panels for areas not served by electricity. They could implement Machine Learning to train the system from past history to warn of flooding. It may be possible to adapt the project to also warn of landslides or storms. These enhancements would augment the usability of the system to warn people before they are impacted by floods and other disasters.

6. REFERENCES

1. M. Castillo-Effen, D. H. Quintela, R. Jordan, W. Westhoff, and W. Moreno, "Wireless sensor networks for flash-flood alerting," in Proceedings of the Fifth IEEE International Caracas Conference on Devices, Circuits and Systems, IEEE, Nov 2004, pp. 142–146.

2. R. Chowdhury, "Consensus seasonal flood forecasts and warning response system (FFWRS): an alternate for non-structural flood management in Bangladesh," Environmental Management, 35, pp. 716–725, 27 May 2005.

3. F. Hossain, N. Katiyar, Y. Hong, and A. Wolf, "The emerging role of satellite rainfall data in improving the hydro-political situation of flood monitoring in the under-developed regions of the world," Journal of Natural Hazards, 43, pp. 199–210, 9 March 2007.

4. S. Saha and M. Matsumoto, "A Framework for Data Collection and Wireless Sensor Network Protocol for Disaster Management," in Proceedings of the 2nd International Conference on Communication System software and Middleware (COMSWARE 2007) Bangalore, India, IEEE, Jan 2007 pp. 7-12.

5. R. Fantacci, M. Vanneschi, C. Bertolli, G. Mencagli, and D. Tarchi, "Next Generation Grids and Wireless Communication networks: Towards a novel integrated approach," Wireless Communications and Mobile Computing, 9, 4, pp. 445-467, 2009.

6. X. Yang, M. Ke, Y. Chen, H. Li, J. Liu, and T. Yang, "Water level measuring network design and implementation," in Information Engineering and Computer Science (ICIECS), 2010, 2nd International Conference on, 2010, Dec.

[7] Kang, W. & Shibata, Y. (2010). Performance Evaluation of Disaster Information System Based on P2P Network. In: 2010 24th IEEE International Conference on Advanced Information Networking and Applications Workshops (WAINA), 20-23 2010. (pp. 710 -715).

[8] De, U.S., Singh, G.P. & Rase, D.M. (2013). Urban flooding in recent decades in four megacities of India. J. Ind. Geophys. Union, April 2013, Volume17 , Number 2, (pp. 153-165).

[9] Xue, X.G., Jiang, S.F., Li, M., et al. (2016). Application Trend of GIS in Urban Drainage and Flooding Prevention. Science & Technology Vision, Number1, (pp. 71-72).

[10] Tong, L.G. (2015). Urban Drainage and Flooding Prevention Intelligent Controlling Platform Based on Internet of Things and GIS. Science& Technology Information, 13, (pp. 10-12).