TO INVESTIGATE THE CATCHMENT AREA OF FLOOD MONITORING AND WARNING SYSTEM BASED ON IOT SENSOR SYSTEM

Guide: Mrs. K. Sreeja, M.Tech., Assistant professor

Mr. DINESH RAHUL[1] Mr. KOLA BALAJI[2] Mr. SURI REVANTH[3]

Mr. GUNDUBOYINA NAGARJUNA[4] Mr. SHAIK IMRAN[5]

[1, 2, 3, 4 & 5] UG Scholars, Narayana Engineering College, Nellore, Andhra Pradesh, India

---

ABSTRACT

Floods are major natural disaster that can cause significant damage to infrastructure, agriculture, and human life. Effective flood monitoring and warning systems (FMWS) are essential to mitigate the impact of flooding. The increasing frequency and severity of flood events due to climate change necessitate the development of innovative solutions for flood risk management. The innovative, cost-effective, and user-friendly FMWS employs an HC-SR04 ultrasonic sensor with an Arduino microcontroller to measure flood levels and determine their status. The Internet of Things (IOT) is a rapidly growing technology that is transforming the way we live and work. IoT refers to the network of physical devices, that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet. The data regarding flood levels and associated risk levels (safe, alert, cautious, or dangerous) are updated on The Things Network and integrated into TagoIO and ThingSpeak IoT platforms through a custom built long-range wide area networks (LORAWAN) gateway. The LORAWAN-based IoT used in this system offers several advantages, including low power consumption, low cost, and long-range communication capabilities, making them ideal for large-scale deployments in remote areas.

Keywords: *LORAWAN, IoT, Flood Warning System, HC- SR04 Ultrasonic Sensor, Arduino Microcontroller, TagoIO and ThingSpeak.*

---

1. INTRODUCTION

Flooding is a devastating natural disaster exacerbated by climate change, leading to loss of life and property, and necessitating improved flood management systems. Traditional monitoring methods often rely on manual data collection, which can be inadequate for timely responses. The integration of Internet of Things (IoT) technology into flood management offers a promising solution, utilizing sensor systems to provide real-time data on environmental parameters like rainfall and river levels, enabling proactive flood risk mitigation. Long-range wide area networks (LORAWAN) enhance this capability by facilitating low-power, long-range communication, crucial for effective disaster management, especially in developing countries. Recent advancements in IoT-based flood monitoring systems have demonstrated the potential for real-time data collection and automated alerts, improving response times and community resilience. Various innovative solutions, such as multi-sensor networks, intelligent flood management systems, and hybrid water management systems, have been developed to enhance flood detection and response. These systems leverage advanced analytics, machine learning, and decentralized communication to ensure timely alerts and effective resource allocation during flooding events. Ultimately, the ongoing research and development in IoT applications for flood monitoring aim to create robust frameworks that enhance emergency preparedness.

2. OBJECTIVE

- To study on the use of IoT for flood management.
- To understand the impact of using Iot for flood management.
- To conduct experimental studies to investigate the success of the IoT on flood management.

- To reduce additional stress on flood disaster workers using IoT.

3. METHODOLOGY

1. **Data collection:** Ultrasonic sensors have emerged as a vital technology for measuring water levels across a variety of applications, including flood monitoring, wastewater management, and environmental studies. These sensors utilize sound waves to determine the distance to the water surface, enabling accurate and reliable measurements. Their ability to provide real-time data makes them particularly valuable in scenarios where water levels can fluctuate rapidly, and timely information is crucial for effective decision-making.
2. **Communication Network:** Transferring data from an ultrasonic sensor to an Arduino for measuring water levels involves several simple steps. First, you need to connect the ultrasonic sensor, like the HC-SR04, to the Arduino. After setting up the hardware, the next step is to write a program for the Arduino. This program tells the Arduino to send a short signal to the trigger pin, which makes the ultrasonic sensor send out sound waves. These sound waves travel through the air, hit the water surface, and bounce back to the sensor. The Arduino measures how long it takes for the sound waves to return.
3. **Data Processing and Storage:** Data processing and storage for ultrasonic sensor data in cloud storage involves collecting data from the sensors, transmitting it to the cloud, and storing it for analysis. The data is processed to extract meaningful insights, and cloud storage allows for scalable, accessible, and secure storage of large volumes of sensor data, enabling real-time monitoring and further applications.
4. **Data Analysis and Prediction:** Data analysis and prediction in ThingSpeak, a cloud-based IoT analytics platform, utilize to help users make sense of their IoT data in real-time. When data is collected from various IoT devices, such as sensors, it is streamed into ThingSpeak for processing. The platform allows users to preprocess this data, which involves cleaning and organizing it to ensure accuracy and relevance. This step is crucial because raw data can often contain noise or errors that could lead to misleading conclusions.
5. **Alerting and Notification:** IoT-based alerting and notification systems for flood control utilize sensors to monitor water levels and environmental conditions in real-time. When these sensors detect that certain thresholds have been exceeded, the systems automatically send alerts via SMS, email, or mobile apps to inform authorities and residents, enabling timely responses to potential flooding events.
6. **User Interface:** The user interface in IoT-based flood control systems plays a crucial role in enabling effective monitoring and management of flood risks. Typically, this interface consists of dashboards and applications designed to provide real-time data visualization, making it easy for users to interpret complex information at a glance. These dashboards display critical metrics such as current water levels, rainfall intensity, and other environmental conditions, allowing users to monitor changes as they occur.

4. MATERIALS USED

1. **Arduino Uno Micro controller:** The Arduino Micro controller is a versatile and widely used platform for building electronic projects. It is based on the Arduino board, which typically includes a micro controller, input/output (I/O) pins, and various other components that facilitate the development of interactive electronic devices.

Fig 1: Arduino Uno Micro controller

2. **HC-SR04 ultrasonic sensor:** The HC-SR04 ultrasonic sensor is widely used in flood monitoring systems due to its ability to accurately measure water levels. It operates by emitting ultrasonic waves and measuring the time it takes for the waves to return, allowing for real-time monitoring of rising water levels, which is crucial for early flood detection and management.

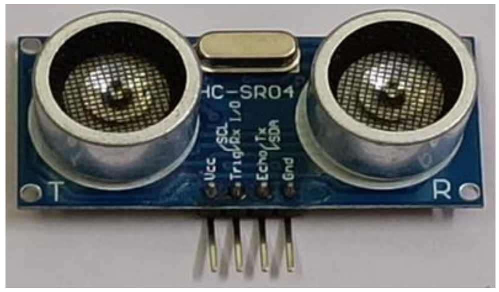


Fig 2: HC-SR04 ultrasonic sensor

3. **NodeMCU ESP8266:** NodeMCU is an open-source firmware and development kit based on the ESP8266 Wi-Fi module, designed for building Internet of Things (IoT) applications. It is favored by hobbyists and developers for its ease of use and flexibility**.**

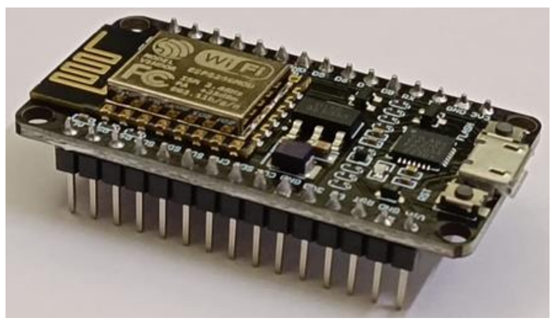


Fig 3: NodeMCU ESP8266

4. **Breadboard:** A breadboard is a reusable platform used for prototyping electronic circuits without the need for soldering. It allows engineers, hobbyists, and students to build and test circuits quickly and easily.

Fig 4: Breadboard

5. **Jumper Wires:** Jumper wires are short electrical wires used to connect points in a circuit, commonly found in electronics and prototyping with breadboards and development boards like Arduino and Raspberry Pi. They come in three main types: male-to-male, male-to-female, and female-to-female, each serving different connection needs. Jumper wires vary in length, typically from a few centimeters to several feet, and in gauge, with 22 AWG being common.

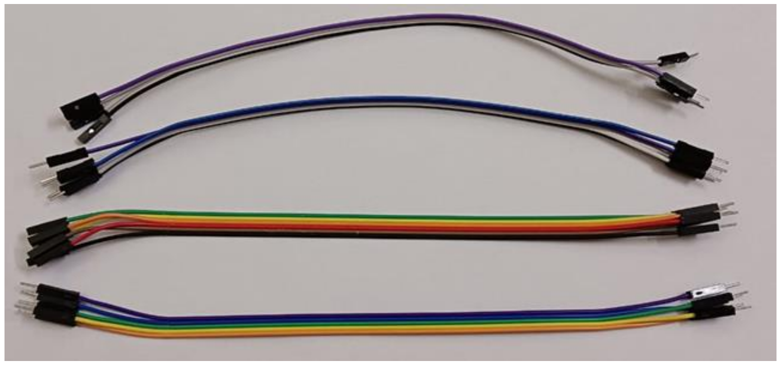


Fig 5: Jumper Wires

6. **Led lights:** LED lights, or Light Emitting Diodes, are energy-efficient and long-lasting lighting options that emit light through electroluminescence. They use up to 80% less power than traditional bulbs and have a lifespan of 15,000 to 50,000 hours, reducing the need for frequent replacements. Available in various colors and dimmable, LEDs are durable, resistant to shock, and produce minimal heat, enhancing safety. While they may have a higher initial cost, they save money over time and are environmentally friendly, containing no harmful substances like mercury.

Fig 6: Led lights

7. **Resistor:** A resistor is a key electronic component that limits or regulates electrical current in a circuit, helping to control voltage levels and protect sensitive components. Measured in ohms (Ω), resistors can be fixed, with a constant resistance value, or variable, allowing for adjustable resistance. Common types include carbon composition, metal film, and wirewound resistors, as well as specialty types like thermistors and photoresistors. Resistors have important characteristics such as resistance value, tolerance, power rating, and temperature coefficient.

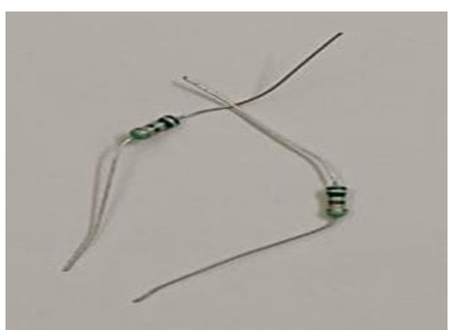


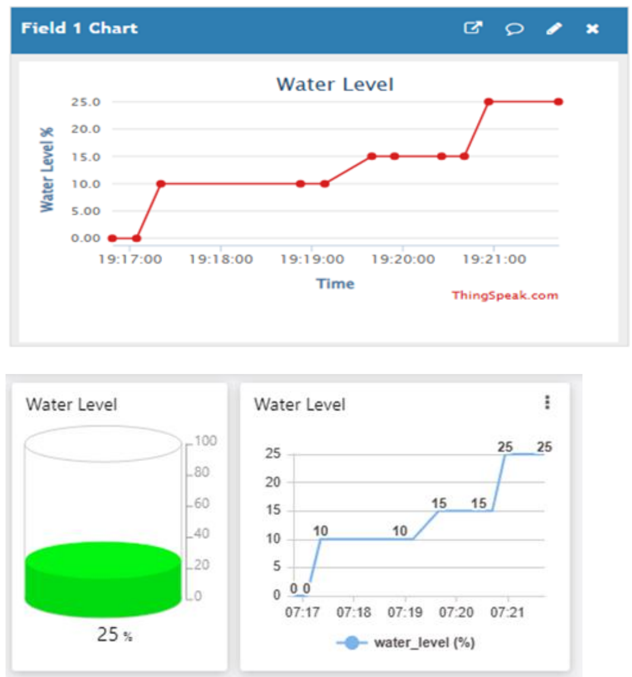
Fig 7: Resistor

5. RESULT AND DISCUSSION

In this section, perform the results of experimental work. The results are displayed in table and graph format.

Table: Water Level Monitoring Data 1

Time	Water Level %
19;16:49	0
19:17:05	0
19:17:21	10
19:18:53	10
19:19:09	10
19:19:40	15
19:19:55	15
19:20:26	15
19:20:41	15
19:20:57	25
19:21:43	25

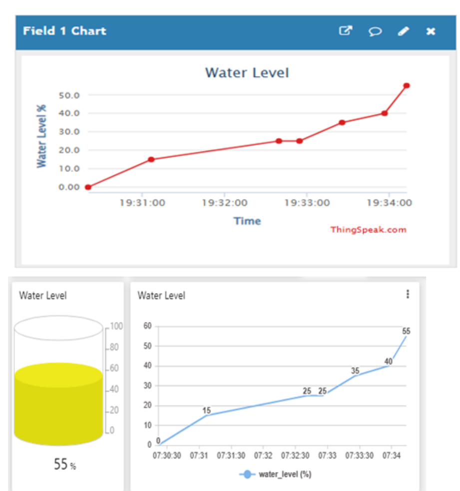


Graph: Water Level Monitoring Data 1

Discussion: Graph represents the water level for a certain time which gradually increase from 0% to 25%.Even though there is drastic increase in water level it does not pose any threat because it is within the danger level. From the above table the data shows the amount of water for a specific time and that data is represented in graph**.**

Table: Water Level Monitoring Data 2

Time	Water Level %
19:30:21	0
19:31:07	15
19:32:40	25
19:32:55	25
19:33:26	35
19:33:57	40
19:34:13	55

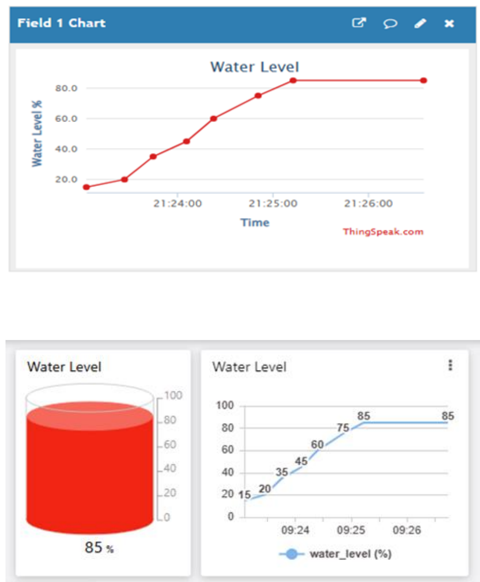


Graph: Water Level Monitoring Data 2

Discussion: Graph represents the water level for a certain time which gradually increase from 0% to 55%.Even though there is drastic increase in water level it does not pose any threat because it is within the danger level. The percentage is within the 60% so it is safe. From the above table the data shows the amount of water for a specific time and that data is represented in graph.

Table: Water Level Monitoring Data 3

Time	Water Level %
21:23:03	15
21:23:27	20
21:23:45	35
21:24:06	45
21:24:23	60
21:24:51	75
21:25:13	85
21:26:35	85



Graph: Water Level Monitoring Data 3

Discussion: Graph represents the water level for a certain time which gradually increase from 15% to 85%. This drastic increase in water level does pose threat because it is above the safe level .The water level is above 60% so it is in danger level. This increase in water level pose a threat so it alerts to take precautionary measures to prevent catastrophic incident. From the above table the data shows the amount of water for a specific time and that data is represented in graph**.**

5. CONCLUSION

Based on the experiment carried out on catchment area to manage the water level using IoT and with the help of sensors.

- The IoT system facilitates real-time monitoring of water levels, as shown through the time series data in the accompanying chart.
- This continuous observation allows for the tracking of changes over time, which is essential for effective water resource management.
- The visual representation of water levels enables stakeholders to easily understand the current situation, with the graph illustrating a gradual increase in levels that may indicate various conditions requiring attention.

6. REFERENCES

1. S. Marzukhi, M.A.S.M. Sidik, H.M. Nasir, Z. Zainol, M.N. Ismail, “Flood detection and warning system (FLoWS)”, in: Proceedings of the 12th International Conference on Ubiquitous Information Management and Communication, ACM, 2018, p. 36.
2. A. Domeneghetti, G.J.-P. Schumann, A. Tarpanelli, “Remote Sensing for Flood Mapping and Monitoring of Flood Dynamics, Multidisciplinary Digital Publishing Institute” 2019.
3. S.I. Khan, Z. Flamig, Y. Hong, “Flood monitoring system using distributed hydrologic modeling for indus river basin”, in: Indus River Basin, Elsevier, 2019, pp. 335–355.

4. S. Wang, J. Zou, Y. Chen, C. Hsu, Y. Cheng, C. Chang, "Long-term performance studies of a LoRaWAN", June 2018, pp. 1–5.
5. L. Maziero, et al., "Monitoring of electric parameters in the federal university of santa maria using LoRaWAN technology", Sept 2019, pp. 1–6.
6. D. Davcev, K. Mitreski, S. Trajkovic, V. Nikolovski, N. Koteli, "IoT agriculture system based on LoRaWAN", June 2018.
7. Minakshi Roy, Prakar Pradhan, Jesson George, Nikhil Pradhan, "Flood Detection and Water Monitoring System Using IOT"
8. N. Bopi, A. Ismail, S. Ahmad Zabidi, M. Hasan, "Development of a river basin monitoring system", Sept 2016.
9. J. Sunkpho, C. Ootamakorn, "Real-time flood monitoring and warning system", 2011.
10. i-SCOOP, "Internet of things case: flood sensor network", April 2023.
11. M. Ancona, A. Dellacasa, G. Delzanno, A. Camera, I. Rellini, "An internet of things vision of the flood monitoring", pp. 26–29, 2015.
12. MI Zakaria, WA Jabbar, N Sulaiman, "Development of a smart sensing unit for LORAWAN-based IoT flood monitoring and warning system in catchment areas", May 2023.
13. MSM Sabre, SS Abdullah, A Faruq, "Flood Warning and monitoring system utilizing internet of things technology", October 2019.
14. MI Hadi, F Yakud, A Fakhrurradzi, NA Fakharulrazi, AN Harun, ZA Rahim, A Azizan, "Designing early warning flood detection and monitoring system via IoT", November 2019.
15. V Tyagi, N Rawat, M Ram, "Reliability modelling and sensitivity analysis of IoT based flood alerting system", April 2021.
16. HFA Sufa, MI Yusof, MAA Sani, "Flood Monitoring and Warning System with IoT", 2019.
17. T Ahmed, M Siddique, MS Husain, "Flood Monitoring and Early Warning Systems- An IoT", 2023.
18. AD Jimale, MO Abdullahi, YA Ahmed, "Mitigating the impact of floods: An IoT-driven monitoring and alert system", June 2023.
19. O Mendoza-Cano, R Aquino-Santos, "Experiments of an IoT-based wireless sensor network for flood monitoring", 2021.
20. A Uwayisenga, "IoT-based system for automated flood water detection and early warning", 2021.
21. ED Sheshu, N Manjunath, S Karthik, "Implementation of flood warning system using IoT", 2018.
22. M Rusdi, MW Lestari, FN Hulu, "River flood early warning system based on internet of things", 2023.
23. SB Zahir, P Ehkan, T Sabapathy, M Jusoh, "Smart IoT flood monitoring system", 2019.
24. F Ardani, D Caesaron, "Design of flood barrier with developed IoT-based flood detection and monitoring systems", December 2023.