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IoT BASED FLOOD MONITORING SYSTEM

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Abstract: This research project is an IoT-based flood monitoring system using ESP8266 Wi-Fi module where measurements are derived with the use of the ultrasonic sensor HC-SR04, providing real-time measurements of the water level. The proposed system aims to enhance detection and response approaches towards flooding. By measuring a probable distance to the water surface, the sensor will allow the system to assess risks associated with the flood. Data after being collected by the sensor, the data will be wirelessly sent to the central server for processing and analysis. It can then be accessed by remote users through a friendly user interface that allows monitoring of flood conditions. The system also has alert mechanisms which notifies users about rising water levels allowing early intervention activities that could reduce the impact brought about by flooding. It demonstrates how IoT can help strengthen resilience for communities at risk of flooding. Results validate the effectiveness of the system in providing critical data for informed decision-making purposes in flood-risk communities, thereby contributing to improved safety and preparedness.

***Keywords*—ESP8266, HC-SR04 Ultrasonic Sensor, Wirelessly, Central Server, Resilience**

1. Introduction

Flooding poses significant risks to communities worldwide, often leading to devastating impacts on lives, property, and infrastructure. As nowadays, most of the people are living in the world of technology. The rise of Internet of Things has made it possible to come up with innovative solutions for such type of natural calamity. The development of flood monitoring systems has changed greatly due to the emergence of Internet of Things (IoT) technologies. At first, modern systems depended on manual observations, but now they use connected sensors like ultrasonic and environmental sensors to track water levels and rainfall. An IoT flood detecting system is used to collects real-time measurements of water levels by advanced devices, including ultrasonic sensor and wireless communication modules. The flood detecting system collects data via Ultrasonic sensor [1] placed in flood prone areas and focuses on the water level of water body. The gateway for the sensors is ESP8266 [2] that collects and processes the received information before uploading it onto the ThinkSpeak cloud platform for further analysis. These data can be accessed by users of ThingSpeak, thus alerting them early on of the rising issue. Its standout feature among many advantages is the fact that the system can alert at the moment when water level

surpasses critical limits. It is based on well-designed algorithms scanning incoming data in search of a pattern indicative of impending flooding. By having Smart IoT Flood Monitoring System will solve all drawbacks of the existing system. The proposed system is preferable to cities and village areas. Secondly, if the public has internet access, then they can monitor what is happening and predict whether there is an onset of flood at the web server. In addition, the proposed system design is cheap and easy to maintain. The System will issue an alert on onset of an upcoming flood to the citizens to which they can respond swiftly and take necessary action early.

2. Literature Review

In the paper IoT [3] enabled water monitoring system by Perumal et al. proposed that water level sensors are integrated with IoT-driven water monitoring systems into social media, like Twitter, Instagram for immediate public warnings in cases of flooding. This framework fosters more effective communication concerning flooding and, therefore, community preparedness and response efficiency. The function of the cloud server in this system ensures data accessibility through remote means, which is essential in ensuring timely intervention [4]. Studies by Zhou et al. highlighted that Deep learning [5] is used in any multitarget detection that can be applied in terms of IoT surveillance systems to monitor floods. Flood prediction could be enhanced using multiple streams of data, thus developing the situation awareness levels [6]. Paper by Anbarasan et al. elaborated about a Flood detection system with the integration of IoT, big data [5], and CDNN [7]. It is one approach that not only facilitates the real-time monitoring of water level but enhances the capacity for better prediction through substantive solutions in flood disaster management [8]. Research by Sood et al. discussed an IoT, big data and HPC [9] based smart flood management framework that may make use of computer vision to further enrich data quality analysis and decision-making capabilities. It is upon such integration that advanced, adaptive monitoring systems for floods could be developed under changing environmental conditions [10]. Bande & Shete proposed an IoT based flood monitoring system with an artificial neural network [11] driven flood prediction mechanism have been developed that would improve the scalability and reliability of flood management systems. This framework is designed to detect humidity, temperature, pressure, precipitation, and river water levels, as well as to analyze their temporal correlations for flood prediction purposes. It employs an IoT-based strategy for gathering data from sensors, facilitating communication via Wi-Fi, while utilizing artificial neural networks (ANN) for the analytical processes involved in flood prediction. [12]. Byalib et al. Their project aimed to develop a flood-monitoring and detection system in real-time using deep learning techniques. The thesis endorsed the use of wireless sensor networking technology as a dependable, energy-efficient solution for communication across large areas in the context of flood detection. Besides that, they use a Convolutional Neural Network [13] to discover the presence of people affected by the flood [14].

3. Design and Simulation

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To design/access this IoT-based flood monitoring system, we need to explain how it works. First, the block diagram and working procedure are shown below. The ultrasonic sensor monitors the water level in the river. The ultrasonic sensor then delivers data to the ESP8266 for processing and analysis, which is subsequently transmitted to the ThingSpeak [16] platform for graphical monitoring and crucial alerts. In this scenario, a red LED signal is used to warn of extreme flood conditions, while a green LED signal indicates normal circumstances.

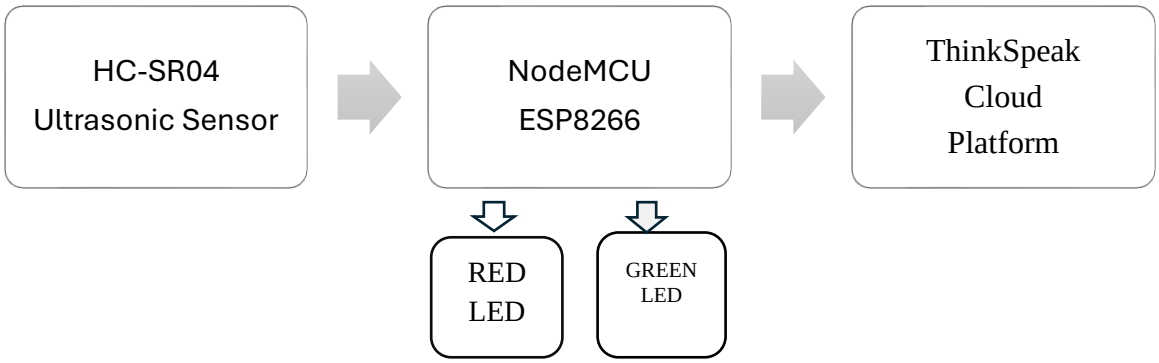

Figure 1: Block Diagram of Iot Based Flood Monitoring System

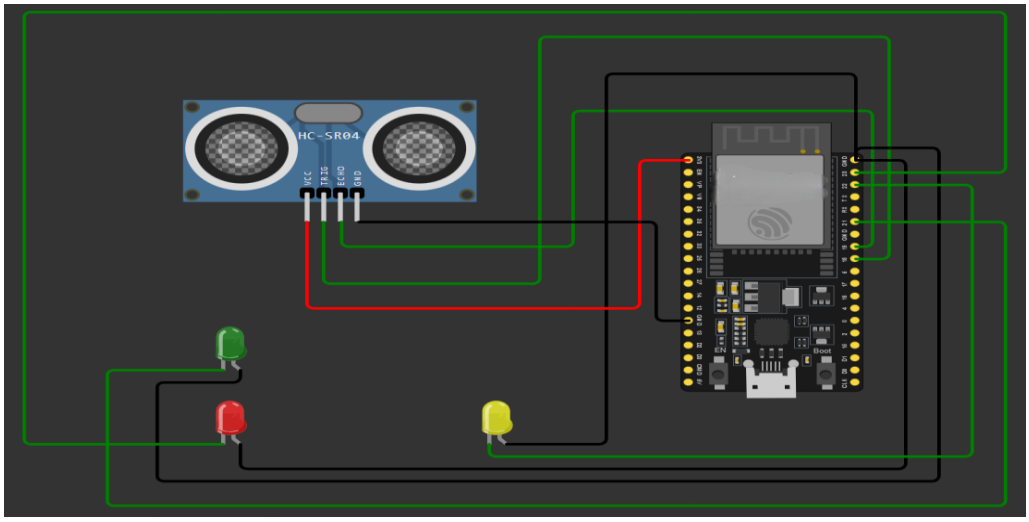

Figure 2: Circuit Design of IoT Based Flood Monitoring System when power not applied

4. Simulation Parameter

Table 1 Components Required for Designing the Circuit

Sl. No.	Components	Specifications
1	ESP8266	1
2	HC-SR04	1
3	Power Supply	5v
4	LED	2
5	Breadboard	1
6	Jumper Wires	8

5. Working Procedure

Initially, the system is set up by connecting the HC-SR04 sensor to the ESP8266 NodeMCU: the VCC pin of the sensor is connected to a 5V power supply, GND to ground, TRIG to GPIO12 (D6), and ECHO to GPIO14 (D5). Then the system operation is initiated by the HC-SR04 ultrasonic sensor emits a 10µs pulse via the TRIG pin, which sends waves of ultrasonics waves towards the water surface. It calculates the distance to the water surface very accurately based on how long it takes for the reflected waves to come back. The retrieved distance measurement is transmitted to the ESP8266 module a powerful microcontroller used as the brain of the system. The distance information it receives through its ESP8266 is processed and measured on the ECHO pin according to the code fed to it which sends data periodically to the cloud platform which connects to a Wi-Fi network. From here, processed data that is, water level data is available on a ThingSpeak IoT cloud. ThingSpeak can act as a hub for collating, visualizing, and analyzing the data. users also have the flexibility to set alerts when predefined thresholds, such as 30 cm or 50 cm, enabling timely interventions to mitigate flooding impact. Here, a red LED is used to alert during the critical flood conditions, and the Green LED is used to indicate the normal condition. By Additional configuration the flooding system will automatically inform through emails or SMS to relevant authorities and stakeholders for timely responses to mitigate eventual damages resulting from flooding, provided the water level overshoots a particular critical point [17].

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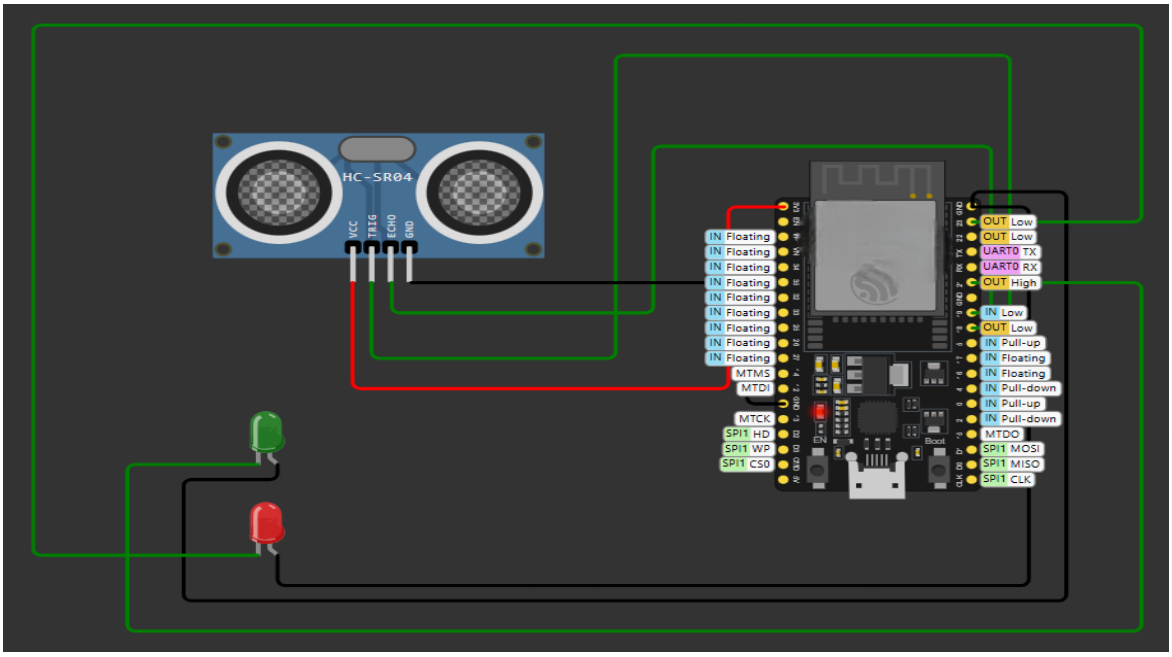

Figure 3: Circuit Design of IoT Based Flood Monitoring System when power applied

6. Result Analysis

We have successfully completed the working of the IoT-based flood monitoring system using the ESP8266, HC-SR04 ultrasonic sensor, and ThingSpeak platform to Conduct Real-Time Water Level Monitoring. Here, the HC-SR04 sensor will measure the time that these pulses take to bounce back after hitting the water level and depth of water thereby, the distances will be computed within a range of 2 cm to 400 cm with an accuracy of 0.3 cm. It then transfers the data obtained to the ESP8266 microcontrollers, which will process the data periodically according to the code fed to the microcontroller which then transmits it to ThingSpeak at preset intervals. Integration with ThingSpeak enables remote visualization such as chart of water levels and automatic alerting when thresholds are reached, thus enhancing community preparedness against flooding. This equipment is user-friendly and can be preferably used by hobbyists or professionals; it can also be deployed in various environments-from urban to rural areas. The overall impact of integrating real-time data collection, cloud-based monitoring, and automated alerts in mitigating flood management strategies produces a reasonable enhancement of socioeconomic impacts associated with flooding events [18].

Figure 4: Visualization of water level on ThingSpeak cloud platform

7. Conclusion

In this paper, we successfully developed a IoT flood monitoring system using ESP8266 Wi-Fi module where measurements are derived with the use of the ultrasonic sensor HC-SR04, again it is very cheap, components are easy to source and also easy to build and design. This is also a DIY (do-it yourself) type of Activity. By leveraging real-time data collection and communication technologies, these systems improve readiness and ability to respond in regions susceptible to flooding, ultimately saving lives and minimizing economic losses. This is a simple prototype for an IoT flood monitoring and alert system, with plenty of opportunities for enhancement. Future enhancements to the system could include the integration of additional sensors to monitor other environmental parameters such as temperature, humidity, water current for more comprehensive understanding of the flood events [19].

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