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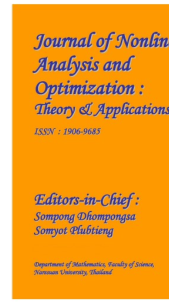

MONITORING WATER QUALITY FLOOD DETECTION & SMART IRRIGATION USING IOT

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ABSTRACT

Since we are now currently present in an era of Computing Technology, it is essential for everyone and everything to be connected to the internet.[1]IOT is a technology that brings us more and more close to this goal. Our project comprises of smart water monitoring system which is a small prototype for flood detection and avoidance system. The model gives a warning after the water level rises to a particular height.[2,3,4] Since it is a small scaled prototype for flood detection and avoidance system, the working of this model is good. This model can be used to greatly reduce the casualties in a devastating event of flood. Pollution of water is one of the main threats in recent times as drinking water is getting contaminated and polluted. The polluted water can cause various diseases to humans and animals, which in turn affects the life cycle of the ecosystem. If water pollution is detected in an early stage, suitable measures can be taken and critical situations can be avoided.[5] To make certain the supply of pure water, the quality of the water should be examined in real-time.The Internet of Things (IoT) is transforming the agriculture industry and enabling farmers to content with enormous challenges they face. Livestock monitoring, conservation monitoring and plant & soil monitoring are the challenges where IoT can be a solution.

KEYWORDS

Water quality indices; Sensor Technology; Internet of things; Practice test;Arduino; Soil moisture sensor.

1.INTRODUCTION

In order to detect and avoid floods in a timely manner, technology plays a very important role. Studies show that such an initiative can really come in handy. In a very recent US flooding due to storms in the Midwest, loss of life and property damage were minimized due to the emergency systems available there.[6,7]"The Influence of Cutout Location on the Postbuckling Response of Functionally Graded Hybrid Composite Plates.On the other hand, North Korea struggled to deal with the displacement of over 300,000 people, approximately 221 deaths and a cost of $6 million- most to feed the homeless survivors, and this all resulted in part from the lack of development of warning systems and information at the community level of the impending flooding. [8]The same was seen in the floods that happened in the Indian states of Kerala and Tamil Nadu.An IoT early flood detection and alert system using the Arduino is thus, a proposed solution to this problem. The system consists of various sensors which are temperature, humidity, water level, flow and ultrasonic sensors and also includes an Arduino controller, a Wi-Fi module, an LCD, an IoT remote server-based platform and an android application with constructed user friendly GUI relaying all the vital information involved in the picture in a visual format. The data from these sensors is constantly fed to an Arduino controller. The Arduino program checks for ant irregularities in the sensor measurements and performs the associated computations. The Arduino also has a Wi-Fi module attached to it, which enables it to send the sensor data to the remote IoT platform using the IoT protocols over the Wi-Fi connection. The LCD is used to display the real-time values of the sensors. These data can also be viewed on the android application, which constantly retrieves the information from the remote IoT platform. If the value of any sensor crosses over a certain threshold value, an alert is sent to the end user via the android application. [9,10]The current methods demand for expensive equipment and centralized, computationally difficult flood detection schemes. This therefore provides an opportunity to use the latest work in information communication technology and sensor networks to solve this problem in such a manner that the overall system balances the minimal cost requirement and limited computational power.[11]Flooding is usually brought on by an increased quantity of water in a water system, like a lake, river overflowing. On occasion a dam fractures, abruptly releasing a massive quantity of water. The outcome is that a number of the water travels into soil, and „flooding" the region.

1.1 Water quality paramaters

Water quality parameters include chemical, physical, and biological properties and can be tested or monitored based on the desired water parameters of concern. [12,13] that are frequently sampled or monitored for water quality include temperature, dissolved oxygen, pH, conductivity, ORP, and turbidity. [14,15]However water monitoring may also include measuring total algae, ISEs (ammonia, nitrate, chloride), or laboratory parameters such as BOD, titration, or TOC.

2.METHODOLOGY

2.1 Material used

Arduino also known as the Arduino UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.[16,17] Water level sensor also known as the water level sensor is a widely used sensor. You can see this sensor in the water level detector and many other places. Water level sensors can be used in our daily life usable things. [18,19]Buzzeris known as A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke. LCD display LCDs has a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.[20,21,22,23]The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register.The Hitachi-compatible LCDs can be controlled in two modes: 4-bit or 8-bit.

2.2 Model preparation water quality

The power of Cloud, IoT, and Big Data Analytics, empowers electronic hardware-based embedded systems to get real-time data and monitoring insights over water quality.[24] Water quality sensors, as mentioned below, embedded with a controller unit, also known as a sensor node, send their data to the IoT Gateway or Edge gateway. It is an IoT device embedded with a microcontroller using the WSN (Wireless Sensor Network) protocol.

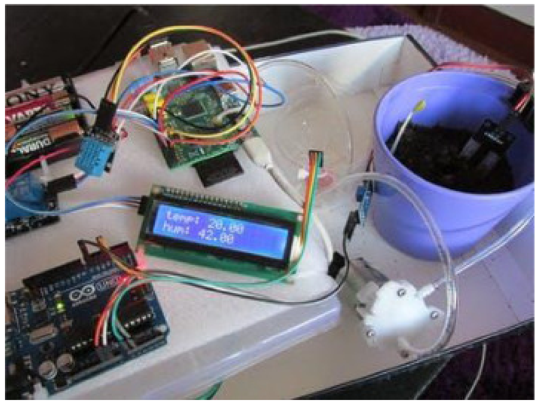


Fig- 1

This data is then sent to a cloud server through the Internet. This Semi-Structured data is stored on the cloud server and trained on Machine Learning algorithms to produce real time information on water quality.[25,26,27] Actuator control systems are also connected through the cloud server, which reacts to the threshold value set by the user. Like whenever any water quality parameter (TDS, pH, temperature) changes in comparison to the threshold value. The set response like SMS, SOS, and control action will be triggered, and an alert will be sent to the user interface or associated application. The information on the cloud can be analyzed and visualized on the user interface, which can be an IoT dashboard or a Mobile Application. Users can also carry out controlling actions based on the processed cloud server data. Data Analysis of weekly/monthly/yearly stored data provides insights to get a good understanding of past data. This will enable better decision-making and planning of water resources for the future.

2.3 Model preparation flood detection

The proposed system for Flood detection system using IOT based on disaster management system. [28]In this system this alert system with GSM module is the system which is Arduino based and deals with the possibility of flood.

Fig-2

The circuit of this system consists Arduino, GSM module, ultrasonic sensors, LCD display and rectifier. The system activates as soon as the water rises from normal level to danger level. The ultrasonic sensor sends the signal at the speed of 10ms at first to sense the water level and sends the signal to Arduino. Arduino is connected with all other parameters. [30]The Arduino reads the signal and sends the signal to LCD display and GSM module if the water level is in abnormal condition. [31,32]The GSM module is a communicative device and used as a method of communication for this project

2.4 PreparationSmartIrrigation

Sensor Deployment: Install soil moisture sensors at different depths and locations within the experimental field. Place weather sensors at strategic positions to monitor environmental

Fig- 3

System Integration: Connect the sensors to the microcontroller and configure communicationprotocols for data transmission. Develop firmware to collect sensor data at regular intervals and transmit it to a central hub.

Data Analysis: Develop algorithms to process sensor data and calculate irrigation requirements based on soil moisture levels, weather forecasts, and plant water needs. [34]Implement decision-making logic to determine optimal irrigation schedules and volumes.

Actuation: Interface the microcontroller with solenoid valves or irrigation actuators to control the flow of water to the crops. Program the system to automatically adjust irrigation parameters according to the analyzed data.

User Interface: Develop a user-friendly interface for farmers to monitor the status of the irrigation system, view sensor data, and make manual adjustments if necessary. Ensure the interface is accessible via web browsers or mobile devices.

3. EXPERIMENT

3.1 Water quality experiment

Define Objectives: Clearly define the goals of the experiment, such as evaluating the effectiveness of IoT sensors in monitoring water quality parameters like pH, turbidity, dissolved oxygen, and conductivity in real-time.

Select IoT Sensors: Choose appropriate IoT sensors capable of measuring water quality parameters. Consider factors such as sensor accuracy, reliability, and compatibility with IoT platforms for data collection and analysis.

Setup IoT Infrastructure: Establish a network infrastructure for IoT communication, including sensors, gateways, and data storage solutions. Configure IoT devices to transmit data securely to a centralized platform.

Sensor Placement: Strategically place sensors in water bodies or water treatment facilities to monitor different water quality parameters. Ensure sensors are placed in locations representative of the overall water body or system.

Data Collection: Record baseline data before initiating the experiment to establish normal water quality conditions. Continuously collect data from the IoT sensors during the experiment, including pH levels, turbidity, dissolved oxygen levels, conductivity, temperature, and any other relevant parameters.

Calibration: Calibrate the IoT sensors according to manufacturer specifications to ensure accurate measurements. Perform periodic calibration checks throughout the experiment to maintain sensor accuracy.

Simulate Contamination Events: Introduce controlled contamination events or changes in water quality parameters to simulate different scenarios, such as pollutant spills or changes in environmental conditions. Gradually introduce contaminants or alter water quality parameters to test sensor responsiveness.

Data Analysis: Analyze the data collected by IoT sensors to monitor changes in water quality parameters over time. Utilize algorithms or machine learning techniques to detect anomalies, identify trends, and predict potential water quality issues.

Validation: Validate the performance of the IoT water quality monitoring system by comparing results with laboratory measurements or established water quality standards. Ensure that the IoT sensors accurately detect changes in water quality and respond appropriately.

Performance Evaluation: Assess the overall performance of the IoT water quality monitoring system based on predefined metrics such as accuracy, precision, response time, and reliability. Evaluate the system's ability to detect and respond to changes in water quality conditions.

Documentation and Reporting: Document the experimental setup, procedures, and results in a detailed report. Include any challenges encountered, lessons learned, and recommendations for improving the IoT water quality monitoring system

3.2 Flood detection experiment

Designing an experiment for flood detection using IoT involves several steps:

Define Objectives: Clearly state the goals of the experiment, such as evaluating the accuracy and effectiveness of IoT sensors in detecting floods, assessing response times, or testing different sensor configurations.

Select IoT Sensors: Choose appropriate IoT sensors capable of detecting water levels, such as ultrasonic sensors, pressure sensors, or conductivity sensors. Ensure they are compatible with IoT platforms for data collection and analysis.

Setup IoT Infrastructure: Establish a network infrastructure for IoT communication, including sensors, gateways, and data storage solutions. Configure IoT devices to transmit data securely to a centralized platform.

Sensor Placement: Strategically place sensors in areas prone to flooding, such as near rivers, streams, or in low-lying regions. Ensure adequate coverage to accurately detect flood events.

Data Collection: Record baseline data before initiating the experiment to establish normal conditions. Continuously collect data from the IoT sensors during the experiment, including water levels, temperature, and humidity.

Simulate Flood Conditions: Introduce controlled flooding scenarios by either manually adding water to the test area or using simulation tools to mimic flood conditions. Gradually increase water levels to simulate different flood magnitudes.

Data Analysis: Analyze the data collected by IoT sensors to detect changes indicative of flooding. Utilize algorithms or machine learning techniques to differentiate between normal conditions and flood events. Evaluate the accuracy of flood detection and response times.

Validation and Calibration: Validate the performance of the IoT flood detection system by comparing results with ground truth data or established flood monitoring systems. Calibrate sensors if necessary to improve accuracy.

Performance Evaluation: Assess the overall performance of the IoT flood detection system based on predefined metrics such as sensitivity, specificity, false positives, and false negatives.

Documentation and Reporting: Document the experimental setup, procedures, and results in a detailed report. Include any challenges encountered, lessons learned, and recommendations for future.

3.3 Smart irrigation experiment:

It consists of aarduino uno (ATmega328) which is the brain of the system. The soil moisture sensor is connected to the input pin of the controller. The water pump, gsm module and the relay are coupled with the output pins. Sensors are placed inside the soil, these sensors uses two probes which sense the moisture level in the soil. Moisture level readings are sent to the arduino controller. Soil sensor is analog; the analog signals are converted into digital form from an inbuilt ADC present in arduino controller. Arduino now alerts the motor to supply the required amount of water to the soil. The motor is programmed to rotate; the rotating platform is attached on the motor to provide a base moment of pipe. If the soil is dry the moisture sensor values will be high, so the pump is turned on using a relay and switched off when the values reaches threshold.

4.Results:

4.1 Result of water quality

We have identified a suitable implementation model that consists of different sensor devices and other modules, their functionalities are shown in figure. In this implementation model we used ATMEGA 328 with Wi-Fi module. Inbuilt ADC and Wi-Fi module connects the embedded device to internet. Sensors are connected to Arduino UNO board for monitoring; ADC will convert the corresponding sensor reading to its dig

sample	PH	Turbidity	Temp in C	Temp in F

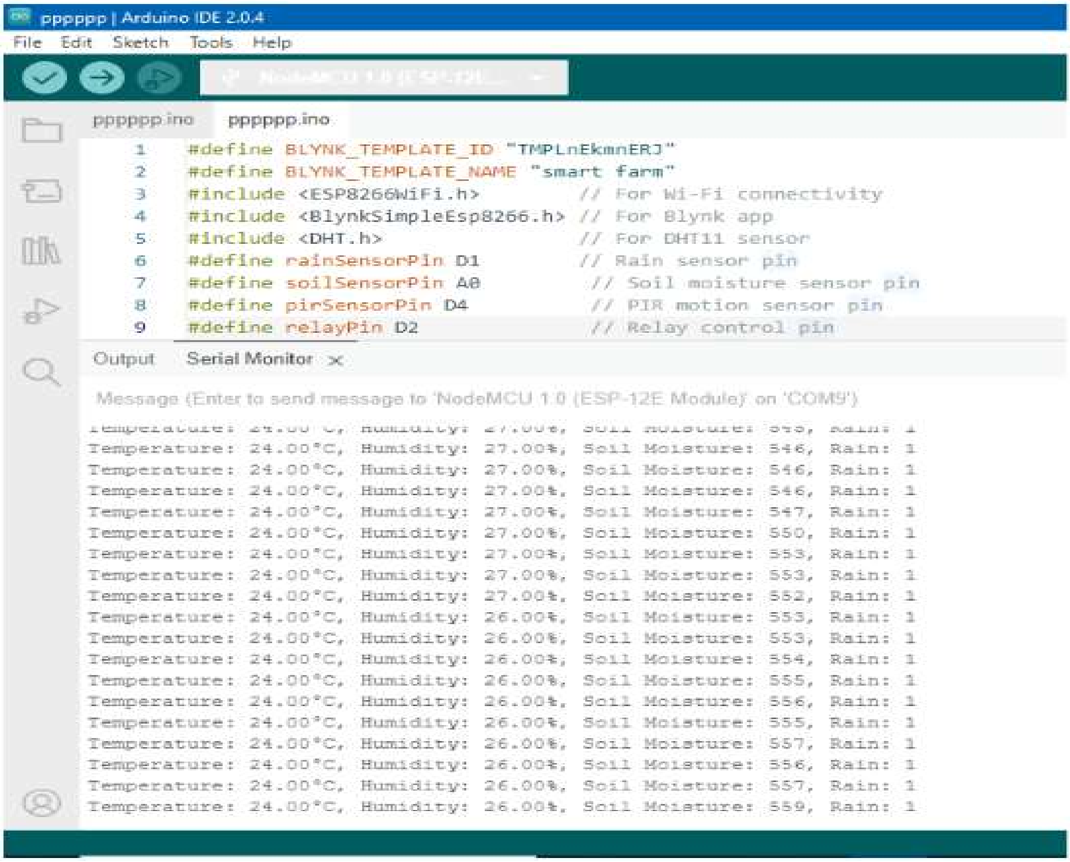
Normal water	6.8	2.5	22	71.6
Polluted water	5.9	91	24	75.2
Tap water	6.2	7.6	26	78.8

Ital value and from that value the corresponding environmental parameter will be evaluated. After sensing the data from different sensor devices, which are placed in particular area of interest. The sensed data will be automatically sent to the web server, when a proper connection is established with sever device.

4.2 Result of flood detection

After successful interfacing and testing we observed the results of system and it meets all requirements and standardsThe entire sensor works fine with all appropriate readings. Each readings/data of sensor is successful provided to user or subscriber through various mediums. Calibration of data is taking place properly. Alerting is 2nd most important task to be performed by this system which has been performed successfully by the system through various mediums. Overall performance of system that been observed is satisfactory.

4.3 Result of smart irrigation



5.Conclusions

5.1 Conclusion of water quality:

The system proposed in this paper is an efficient, inexpensive IoT solution for real-time water quality monitoring. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.The future scope of this project is monitoring environmental conditions, drinking water quality, treatment and disinfection of waste water etc. This system could also be implemented in various industrial processes. The system can be modified according to the needs of the user and can be implemented along with lab view to monitor data computers.

5.2 Conclusion of flood detection

Nowadays the Internet Of things (IoT) is broadly used in worldwide, this system will display the data of the water level measured on lcd display. This project can be very helpful to the Meteorological Department to continuously monitor the dams and river beds water level. With this project it can save many people lives by giving alerts when the water level crosses beyond the limit. This project is very cost-effective, flexible and productive in areas where flood conditions.

5.3 Conclusion of smart irrigation

We have successfully designed and implemented a smart irrigation system using the concept of Internet of Things. This automated irrigation system is easily controlled using a computer. It behave as an intelligent switching system that detects the soil moisture level and irrigates the plant if necessary. This will also save time and energy, as well as minimize energy loss. With the use of sensors whose cost is low and with simple circuitry this experiment aims in low cost solution, which can be bought even by a poor farmer and it is also easy to implement.

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