Smart Water Management For Indian Institutions And Organizations

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***Abstract*–Water management in India is a huge and complex problem due to increasing populations, rapid urbanization, low availability of water resources and environmental issues such as climate change. As the demand for clean potable water keeps rising, Indian institutions and organizations are facing tremendous challenges such as lack of regulatory frameworks and limited investments towards infrastructure maintenance. To overcome this, we propose a novel solution using smart Internet of Things (IoT) devices and advanced sensors for efficient water management. This system would include a mechanism for automatically turning off and on the motor based on the water levels and alert the user, sensor-based monitoring of water consumption and quality, and calculation of quality of water so as to prevent waterborne diseases. This system would be implemented in households and institutions across India to help address the water management crisis and improve the overall health and well-being of the population. Additionally, with powerful insights into the usage patterns, users can make informed decisions about how to better optimize the water resources for long term sustainability. Therefore, it is important for all stakeholders, including government organizations, industries, and individuals, to work together to address this issue through the use of responsible water management techniques and the implementation of effective laws and regulations. Our proposed solution can go a long way in not only saving water but also improving the overall health and quality of life of individuals by providing them with clean and safe drinking water.**

I. INTRODUCTION:

The practice of organizing, creating, allocating, and managing the best use of water resources is referred to as water management. This has an impact on a number of fundamental aspects of human life, including food production, water use, sewage treatment, irrigation, purification, energy production and use, etc.

Information and communications technology (ICT) standards for water are lacking, which prohibits an efficient interoperability, this raises the price and maintenance requirements for new products. In the modern world, there are several tiny, regional manufacturers of niche products in a weak and disjointed market. The control and monitoring of water distribution networks are in danger due to the virtually complete lack of adoption of complicated and interoperable systems, which also prevents their evolution and necessary changes.

In order to avoid the issues faced like the overflow of waters from water tanks while the water motor is running or the issues caused when there is less amount of water in the tank we have come up with a novel solution using sensors to alert the user to turn off the motor when the water in the tank reaches a certain level or to also turn on the motor when there is less amount of water in the tank. We can also detect the water consumption rate and also suggest methods to reduce it. By using the correct water quality measuring sensors we can also detect the water quality and take necessary actions if the quality of the water is not up to the mark.

II. LITERATURE REVIEW:

"Investigation of Some Selected Water Quality Parameters of the Buriganga River" by Islam et al. (2018)

This research paper assesses the water quality parameters of the Buriganga River in Bangladesh, which is severely polluted due to human activities. The study collected water samples from nine different locations along the river and analyzed them for various parameters such as pH, turbidity, dissolved oxygen, and biochemical oxygen demand. The results showed that the water quality of the Buriganga River is extremely poor and poses a threat to human health and aquatic life.

"Development of river water quality management using fuzzy techniques" by Siti Fatimah Che Osmi et al. (2016)
This review paper discusses the use of fuzzy logic and neural network models for water quality management in rivers. The study highlights the importance of accurate and timely water quality monitoring for effective management and proposes the use of advanced modeling techniques to predict water quality parameters. The review concludes that the integration of fuzzy logic and neural network models can lead to more accurate predictions and better decision-making in water quality management.

"IOT based smart aquaculture system with automatic aerating and water quality monitoring" by Tsai et al. (2022)
This research paper proposes an IoT-based real-time water quality monitoring system for aquaculture farms. The system uses sensors to collect water quality data such as temperature, pH, and dissolved oxygen levels, which are transmitted wirelessly to a central database for storage and analysis. The system also includes a web-based dashboard for visualization and monitoring of the data. The study demonstrates the effectiveness of the proposed system in detecting water quality anomalies and enabling prompt action to mitigate potential risks.

"IoT based Smart Water Quality Monitoring System" by Varsha Lakshmikantha et al.
This research paper developed a core controller with various sensors that included pH, temperature, Conductivity and the sensors for turbidity were also included. These sensors will monitor if the value exceeds the threshold value. Thus they evaluated if the water is drinkable or not with a set of specific parameters. They have used completely wired sensors for detecting and latest sensors used do not meet the IoT level communication standards

" Development of IoT for Automated Water Quality Monitoring System" by Rizqi Putri Nourma Budiarti et al.
Raspberry pi embedded systems are used in the sensors and remote communication technology will enable the user to send and receive data. They created an infrastructure and a Web UI(using PHP and HighChart Javascript) for the database. To get the data from the passive sensor they used a Web scraping technique, which was implemented through python programming. The transmission of data was successful using MQTT protocol. For retrieving the data from the sensors they have used python programming in which a module called pySerial was used for the same. The sensors also gave a final report of the water.
Limitations: the research was on a smaller scale level. Application of this IoT system on a large scale might not be cost effective and would require a large amount of resources

III. CONTRIBUTION OF THE PROJECT:

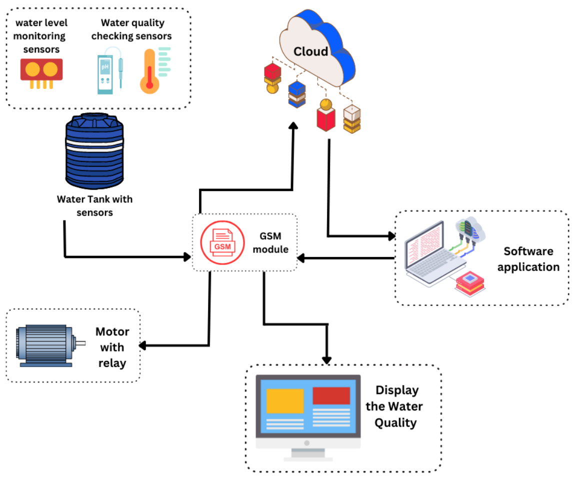
The scope for IoT-based smart water quality checking and water level detecting systems in Indian institutions is vast, and it can have numerous benefits for various stakeholders. Some of the potential scopes for such systems are:
Improving the quality of drinking water: By continuously monitoring the water quality parameters, the system can ensure that the water supplied to the institution is safe and free from contaminants. This can help in reducing the risk of waterborne diseases among the members of the institution.
Ensuring sustainable water management: The system can help in promoting sustainable water management practices by monitoring the water level in storage tanks or reservoirs and promoting efficient use of water.
Minimizing water wastage: By identifying any overflow stage in the water supply system, the system can help in minimizing water wastage and promoting water conservation.
Enhancing operational efficiency: By providing real-time data and alerts, the system can help in improving the operational efficiency of the water supply system in the institution.
Promoting awareness and education: The system can help in promoting awareness and education among the members of the institution about the importance of water conservation and sustainable water management practices.
Compliance with regulations: The system can help in ensuring compliance with the water quality standards set by regulatory authorities, and avoiding any legal or regulatory issues related to water management.

IV. PROPOSED METHODOLOGY:

The device's ultrasonic Smart Level sensor continuously monitors the tank's water level height and uploads that data to the internet once per minute. With a microprocessor and UR detector, the GSM/GPRS module may send data to the cloud, where it can be stored and accessed remotely. IoT devices upload information to the cloud, which can be evaluated later. Users can tell the system to alert them if a specific threshold is met. Overflows in water systems can be spotted quickly by real-time monitoring. Decisions can be made in real-time with the use of cloud computing. An increasing number of IoT devices are used in the water management system. Now that inexpensive sensors can be linked to the Internet of Things devices, we can more accurately assess water quality.

Relay-connected motors control the water pump. The GSM module controls the motor and relay to respond to a signal and turn the motor on or off. The cloud serves as a repository for the data collected, and it is this data that is analyzed and shown. The software will automatically check the water tank's current level since it regularly pulls data from the cloud. The application will signal the motor to turn the motor controller on or off. The app can remotely turn the motor on or off by sending a text message to the GSM network in the motor control device. The software will also pull the data obtained from the pH sensors, turbidity sensors and temperature sensors which is also stored in the cloud for analyzing it by comparing it with the threshold set by the Central Pollution Control Board and displays the output(measure of water quality)

V. MODEL ARCHITECTURE:



VI. MODULE DESCRIPTION:

Water level sensor: This module is responsible for measuring the water level in the tank. There are various types of water level sensors available such as ultrasonic, capacitive, and pressure sensors. The sensor would be placed in the water tank, and it would send signals to the microcontroller when the water level reaches a certain threshold.

Microcontroller: A microcontroller is the brain of the system, which receives the signals from the water level sensor and processes them. Based on the processed data, the microcontroller sends signals to the water motor to turn on or off automatically. Arduino and Raspberry Pi are popular microcontrollers used in IoT based systems.

Water motor: The water motor is responsible for pumping water from the tank to the outlet. When the water level in the tank reaches the set threshold, the microcontroller sends signals to the water motor to turn on automatically.

Water quality sensor: This module is responsible for measuring the quality of water. There are various types of water quality sensors available such as pH sensors, turbidity sensors, and conductivity sensors. The sensor would be placed in the water tank, and it would send signals to the microcontroller with the quality value.

Display module: The display module is responsible for displaying the water quality value. The microcontroller would send the data to the display module, which would then display it on the screen. OLED, LCD, and LED displays are popular display modules used in IoT based systems.

Overall, the water level sensor and water quality sensor provide the necessary input data to the microcontroller, which then sends the output signals to the water motor and display module, respectively. This integrated system allows for efficient and automated water management.

VII. HARDWARE / SOFTWARE REQUIREMENTS:

Hardware Requirements:

1. Smart Level Sensors: To continuously monitor the water level in tanks and reservoirs
2. pH Sensors: To measure the acidity or alkalinity of water
3. Turbidity Sensors: To measure the amount of suspended particles in water

4. Temperature Sensors: To measure the temperature of water
5. Conductivity Sensors: To measure the amount of dissolved solids in water
6. Microprocessor: To control the functioning of the sensors and send data to the cloud
7. GSM/GPRS Module: To send data to the cloud using cellular networks
8. Relay-connected Motors: To control the water pump
9. Cloud Storage: To store and access data remotely

Software Requirements:
1. IoT Platform: To collect data from the sensors and relay it to the cloud
2. Cloud Computing: To store and analyze data in real-time
3. Data Analytics: To analyze the data and provide insights on water quality trends and patterns
4. Alerting System: To alert concerned authorities in case of any overflows or shortages
5. Motor Controller Software: To control the functioning of the water pump based on the data collected from sensors
6. User Interface: To allow users to monitor water quality and level, set thresholds, and receive alerts
7. Compliance Software: To ensure compliance with regulatory standards set by authorities like the Central Pollution Control Board.

VIII. IMPLEMENTATION

Water Level Detection:

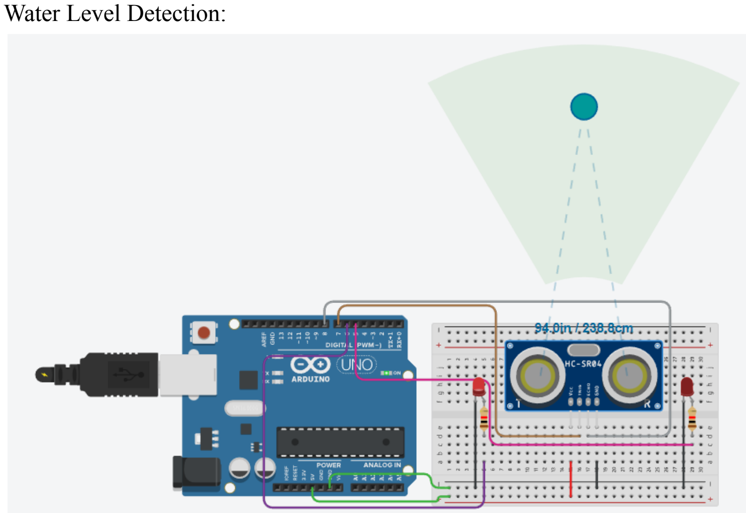
1. Set the ultrasonic sensor with trigger pin at 7 and echo pin at 8.
2. If sensor value goes beyond 30(water level), set pin 6 to high and pin 5 to low, else set pin 5 to high. 5 and 6 correspond to the LED lights.

Water Quality Monitor:

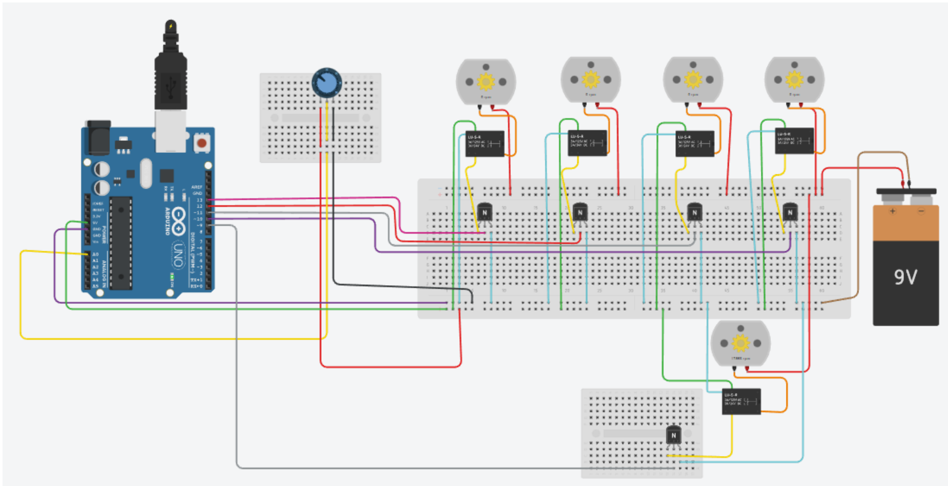
1. In the setup() function, the code initializes the pins as either inputs or outputs and starts a serial communication with a baud rate of 9600. The setup() function also contains four for loops that perform the following actions:
    a. The first for loop takes 100 pH readings, compares them to a pH value of 6.5, and if the pH value is less than 6.5, opens valve1 to sample water and prints a message to the serial monitor indicating that water sampling is done. The motor is turned off during water sampling. If the pH value is greater than 6.5, the motor is turned on.
    b. The second for loop is similar to the first, but it samples water using valve2 instead of valve1.
    c. The third for loop is similar to the first, but it samples water using valve3 instead of valve1.
    d. The fourth for loop is similar to the first, but it samples water using valve4 instead of valve1.
2. In the loop() function, the code takes a pH reading every 5 seconds and prints the value to the serial monitor. If the pH value is less than 6.5, the motor is turned on for 10 seconds, and then turned off. If the pH value is greater than 6.5, the motor is turned on and remains on.

IX. RESULTS

Water Level Detection:



Water Quality Monitor:



X. CONCLUSION

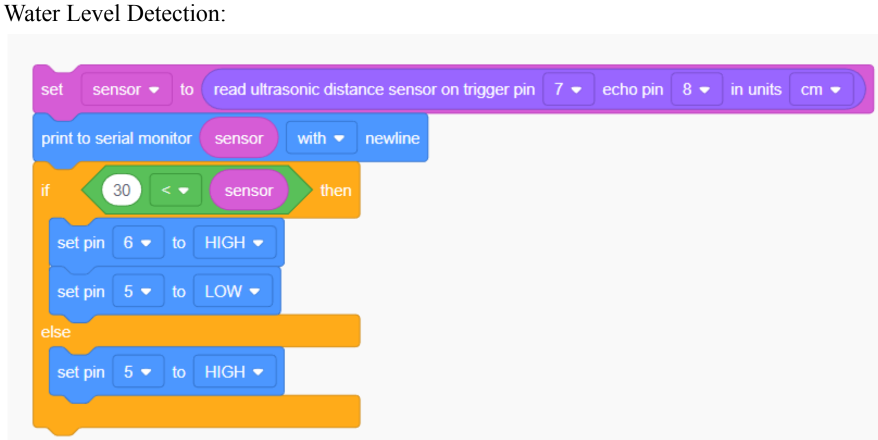
In conclusion, the issue of water management in India is a significant problem that needs to be addressed. The combination of increasing populations, rapid urbanization, and environmental issues such as climate change have contributed to a lack of available clean drinking water, resulting in over 163 million Indians without access to clean water. The use of an IoT-based water monitoring system, as proposed in this project, could help prevent water waste and contamination, as well as provide insight into water consumption rates and water quality. This system could be implemented in households and institutions across India to help address the water management crisis and improve the overall health and well-being of the population. It is crucial that all stakeholders, including government organizations, industries, and individuals, work together to address this issue through the use of responsible water management techniques and the implementation of effective laws and regulations.

XI. SCOPE OF FUTURE WORK

One potential area of future work for an IoT based smart water monitoring system with automated water level and quality management is the integration of machine learning algorithms. Machine learning algorithms could be used to analyze historical data on water usage, quality, and other relevant factors, and make predictions about future water usage and quality. These predictions could be used to optimize the system's performance, by adjusting the water level threshold or frequency of water quality readings, for example. Additionally, machine learning algorithms could be used to detect anomalies in water quality, such as changes in pH or turbidity, and automatically alert the system administrator to potential issues. Overall, the integration of machine learning algorithms could significantly enhance the capabilities of an IoT based smart water monitoring system, making it more efficient, effective, and intelligent.

XII. APPENDIX

Water Level Detection:



Water Quality Monitor Code:

```
int sensorpH = A0;
int valve1 =10;
int valve2 =11;
int valve3 =12;
int valve4 =13;
int motor =9;
int potValue;
int  pH;
void setup()
{
  pinMode(sensorpH, INPUT);
  pinMode(valve1,OUTPUT);
  pinMode(valve2,OUTPUT);
  pinMode(valve3,OUTPUT);
  pinMode(valve4,OUTPUT);
  pinMode(motor,OUTPUT);
  Serial.begin (9600);
   for(int i=1; i<=100; i++){
    potValue = analogRead(A0) ;
    float pH = potValue * (14.0/1023.0);
    Serial.print("pH Value:");
    Serial.println(pH);
    digitalWrite(motor, HIGH);
    if(pH<6.5){
      Serial.print("pH Value:");
         Serial.println(pH);
         digitalWrite(motor, LOW);
      digitalWrite(valve1, HIGH);
      delay(10000);
      Serial.println("SAMPLE WATER 1 IS DONE");
      digitalWrite(valve1, LOW);
      delay(2000);
      digitalWrite(motor, HIGH);
      delay (10000);
      break;
    }
    if(pH>6.5){
      digitalWrite(motor, HIGH);
    }
  }
  for(int i=1; i<=100; i++){
    potValue = analogRead(A0) ;
    float pH = potValue * (14.0/1023.0);
    Serial.print("pH Value:");
    Serial.println(pH);
    digitalWrite(motor, HIGH);
    if(pH<6.5){
      Serial.print("pH Value:");
         Serial.println(pH);
         digitalWrite(motor, LOW);
      digitalWrite(valve2, HIGH);
      delay(10000);
      Serial.println("SAMPLE WATER 2 IS DONE");
      digitalWrite(valve2, LOW);
      delay(2000);
      digitalWrite(motor, HIGH);
      delay (10000);
      break;
    }
    if(pH>6.5){
      digitalWrite(motor, HIGH);
    }
```

```
  }
  for(int i=1; i<=100; i++){
    potValue = analogRead(A0) ;
    float pH = potValue * (14.0/1023.0);
    Serial.print("pH Value:");
    Serial.println(pH);
    digitalWrite(motor, HIGH);
    if(pH<6.5){
      Serial.print("pH Value:");
         Serial.println(pH);
         digitalWrite(motor, LOW);
      digitalWrite(valve3, HIGH);
      delay(10000);
      Serial.println("SAMPLE WATER 3 IS DONE");
      digitalWrite(valve3, LOW);
      delay(2000);
      digitalWrite(motor, HIGH);
      delay (10000);
      break;
    }
    if(pH>6.5){
      digitalWrite(motor, HIGH);
    }
  }
  for(int i=1; i<=100; i++){
    potValue = analogRead(A0) ;
    float pH = potValue * (14.0/1023.0);
    Serial.print("pH Value:");
    Serial.println(pH);
    digitalWrite(motor, HIGH);
    if(pH<6.5){
      Serial.print("pH Value:");
         Serial.println(pH);
         digitalWrite(motor, LOW);
      digitalWrite(valve4, HIGH);
      delay(10000);
      Serial.println("SAMPLE WATER 4 IS DONE");
      digitalWrite(valve4, LOW);
      delay(2000);
      digitalWrite(motor, HIGH);
      delay (10000);
      break;
    }
    if(pH>6.5){
      digitalWrite(motor, HIGH);
    }
  }
}
void loop(){
     potValue = analogRead(A0) ;
   float pH = potValue * (14.0/1023.0);
   Serial.print("pH Value:");
   Serial.println(pH);
  delay(5000);
   if(pH<6.5){
   digitalWrite(motor, HIGH);
     delay(10000);
  }
  else{
    digitalWrite(motor, HIGH);
  }
}
```

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