IOT-based Smart Water Management System

Submitted to Manipal University, Jaipur

Towards the partial fulfillment for the Award of the Degree of

BACHELORS OF TECHNOLOGY

In Computer Science Engineering spec. Internet of things

2023-2024

Of IOT-B

Submitted by

Yash Rajput-229311221

Aagaaz Kapoor-229311030

Pranjal Shah– 229309149

MANIPAL UNIVERSITY JAIPUR

INSPIRED BY LIFE

Under the guidance of

Dr. Hemlata Goyal

Department of Computers and Intelligent systems

Manipal University Jaipur

Objective:

Design a system to monitor and manage water levels, track water usage, detect leakage, and control the water flow using IoT technology. The system can also measure environmental factors such as temperature, humidity, and pressure.

Components:

1. *Water Level Sensor:* To monitor the water level in the tank.

2. *NodeMCU (ESP8266):* For wireless communication and connecting the system to the internet (IoT).

3. *Arduino Uno:* As the main controller for processing data from various sensors.

4. *Buzzer:* To alert users in case of water overflow or shortage.

5. *LCD Display:* To display real-time water level, temperature, humidity, and water pressure.

6. *Temperature Humidity Sensor (DHT11/DHT22):* To monitor the temperature and humidity around the water source.

7. *5V Relay Module:* To control the water pump (based on water levels or user commands).

8. *L293D Motor Driver + Stepper Motor:* To control valves or any moving parts like controlling the water inlet.

9. *Pressure Meter (HX711):* To measure water pressure in the pipeline.

10. *Sonar Sensor (Ultrasonic):* For distance measurement to check water level in the tank.

11. *RFID (RC522):* For user authentication to allow access to water (can be used for smart water management in public places or industrial systems).

12. *LED:* To indicate system status (e.g., water level low, system online, etc.).

13. *Transistor:* To switch higher current loads (such as motors or pumps).

14. *NV-RAM (DS3231):* To keep a record of water consumption and timestamps for system logs, even during power outages.

Features:

1. *Water Level Monitoring:* Using the sonar sensor and water level sensor to track the level of water in the tank and display it on the LCD. When the water level drops below a certain threshold, the relay activates the pump.

2. *Pump Control:* Based on water levels or user input (via the IoT app), the system can automatically control the water pump. The motor driver can control valves for precise water distribution.

3. *Environmental Monitoring:* Using the temperature and humidity sensor, the system can monitor surrounding conditions. This data can be useful for determining water evaporation rates or optimizing irrigation systems.

4. *Pressure Monitoring:* The pressure meter module (HX711) can track water pressure in pipes, ensuring the system operates within safe limits. If the pressure drops suddenly, it may indicate a leak.

5. *User Authentication (RFID):* In a public or industrial setting, RFID can be used to track water usage by authorized users only, preventing unauthorized access to water sources.

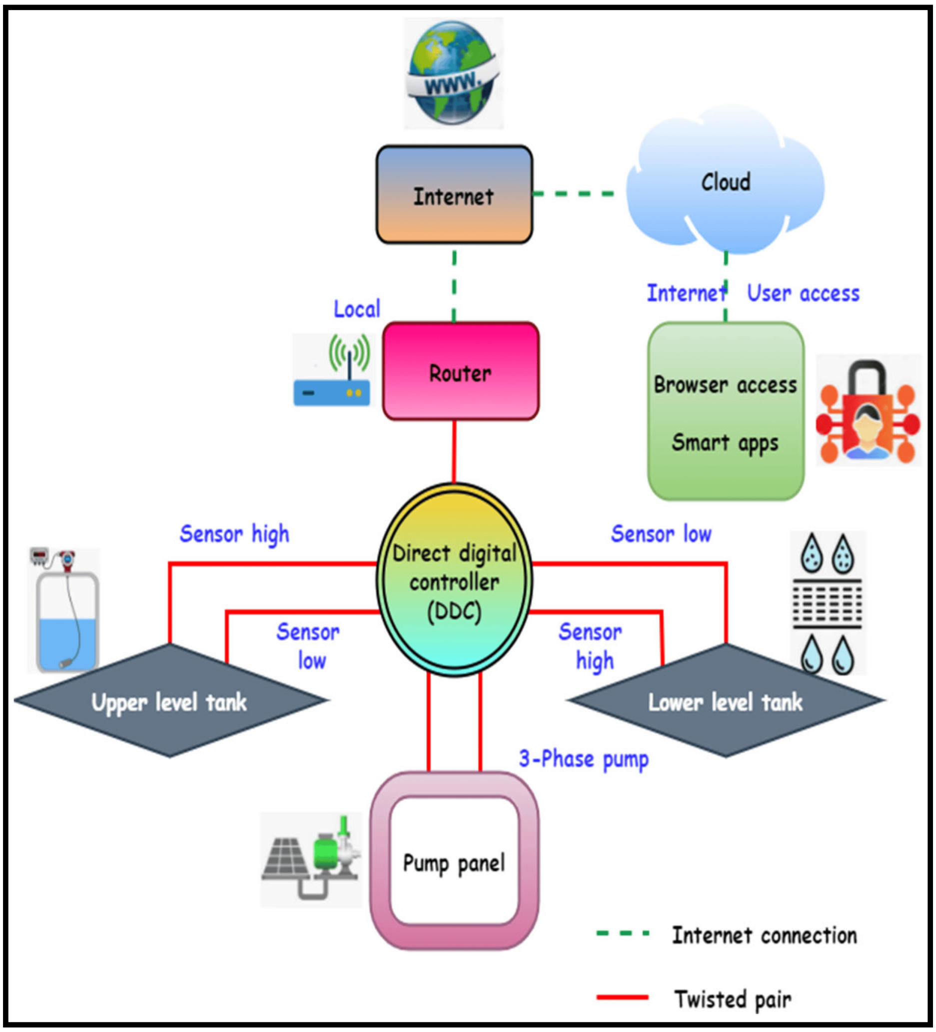
6. *IoT Connectivity:* The NodeMCU (ESP8266) will send all sensor data to the cloud, allowing remote monitoring via a smartphone or web app. Users can also control the pump or check water consumption remotely.

7. *Leak Detection & Alerts:* If abnormal pressure readings are detected, the system triggers a buzzer to alert the user of potential leaks. Notifications can also be sent via IoT.

8. *Smart User Interface (16 Key 4x4 Matrix):* For manual control or inputting commands to control the pump, set thresholds, or switch between operational modes.

9. *Water Consumption Log:* Using the NVRAM from DS3231 to log water usage and system activity, the system can maintain accurate records over time, even when power is lost.

*Digram:



*Pseudo Code:

```
const int TRIG_PIN = D5; // The ESP8266 pin D5 connected to Ultrasonic Sensor's TRIG pin
const int ECHO_PIN = D6; // The ESP8266 pin D6 connected to Ultrasonic Sensor's ECHO pin
const int RELAY_PIN = D7;//relay connected to esp8266

float duration_us, distance_cm;

void setup() {
  // begin serial port
  Serial.begin (9600);

  // Configure the trigger pin to output mode
  pinMode(TRIG_PIN, OUTPUT);
  // Configure the echo pin to input mode
  pinMode(ECHO_PIN, INPUT);
  pinMode(RELAY_PIN, OUTPUT);
}

void loop() {
  digitalWrite(RELAY_PIN, LOW);
  // Produce a 10-microsecond pulse to the TRIG pin.
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  // Measure the pulse duration from the ECHO pin
```

```
  duration_us = pulseIn(ECHO_PIN, HIGH);

  // calculate the distance
  distance_cm = 0.017 * duration_us;

  // print the value to Serial Monitor
  Serial.print("distance: ");
  if(distance_cm<5){
    digitalWrite(RELAY_PIN, HIGH);
    Serial.print("water level reached relay on");

  }
  Serial.print(distance_cm);
  Serial.println(" cm");

  delay(500);
}
```

Innovative Aspect:

This project integrates multiple functions (environmental monitoring, leakage detection, automatic pump control, water usage tracking) into a single IoT system. It can be scaled to fit households, industrial plants, or even public water supply systems.

You can simplify the project by removing the joystick and any unnecessary components depending on your final design.

Future Aspect:

1. Predictive Maintenance: Integrate machine learning algorithms to predict potential failures in the water management system, enabling proactive maintenance.

2. Real-time Water Quality Monitoring: Incorporate sensors to monitor water quality parameters like pH, turbidity, and contaminant levels, ensuring safe drinking water.

3. Automated Leak Detection: Implement advanced sensors and algorithms to detect leaks and alert authorities, reducing water loss and waste.

4. Smart Irrigation Systems: Integrate weather forecasts and soil moisture sensors to optimize irrigation schedules, minimizing water consumption.

5. User Engagement Platforms: Develop mobile apps or web portals for users to monitor their water usage, receive alerts, and access educational resources.

6. Integration with Other Smart City Systems: Collaborate with energy, transportation, and waste management systems to create a comprehensive smart city infrastructure.

7. Advanced Data Analytics: Utilize cloud-based data analytics to identify trends, optimize water distribution, and predict future water demands.

8. Cybersecurity Enhancements: Implement robust security measures to protect the system from cyber threats and ensure data privacy.

9. Expansion to Rural Areas: Adapt the system for rural areas, addressing unique challenges like limited connectivity and infrastructure.

10. International Standards and Compliance: Ensure the system meets global water management standards and regulations, facilitating adoption worldwide.

These future aspects will enhance the system's efficiency, sustainability, and user experience, making it a comprehensive solution for smart water management.

Conclusion:

The Smart Water Management System is an innovative solution that leverages IoT technology, sensors, and data analytics to optimize water distribution, reduce waste, and promote sustainability. By automating monitoring and control, providing real-time insights, and enabling predictive maintenance, this system:

1. Enhances water supply efficiency
2. Detects leaks and prevents water loss
3. Optimizes irrigation schedules
4. Improves water quality monitoring
5. Engages users through education and awareness
6. Supports data-driven decision-making
7. Fosters a culture of sustainability

By implementing this system, cities and communities can:

1. Conserve water resources
2. Reduce operational costs
3. Improve public health and safety
4. Enhance quality of life
5. Support economic growth and development

The Smart Water Management System is a forward-thinking solution that addresses the complex challenges of modern water management, making it an essential tool for creating a more sustainable and resilient future.