Smart Water System

IoT with IBM GROUP 2

Project description:

A smart water management system is a comprehensive and technologically advanced solution designed to monitor, control, and optimize the use and distribution of water resources. It leverages various sensors, data analysis, and automation to improve water conservation, reduce waste, enhance water quality, and ensure the efficient and sustainable management of water.

Hardware connection used:

- DHT22.VCC.Pin.to.3.3V
- DHT22 SDA Pin to GPIO Pin 15
- 10K ohm pull-up resister from DHT22 SDA Pin to 3.3V
- DHT22 GND Pin to GND

Define Project Scope:

- Determine the scope and scale of your smart water management system (e.g., residential, commercial, or municipal).
- Identify specific goals and objectives, such as reducing water waste, improving water quality, or optimizing distribution.

Hardware Selection:

- Choose appropriate sensors and devices for monitoring and controlling water resources.
- Select sensors for flow measurement, pressure monitoring, water quality analysis, and leak detection.

IoT Platform and Cloud Services:

Choose a robust IoT platform (e.g., AWS IoT, Google Cloud IoT, or Azure IoT) and cloud services for data storage, processing, and analytics.

Hardware Setup:

- Connect sensors and actuators to microcontrollers or IoT devices.
- Configure devices to communicate with the chosen IoT platform.

Data Collection and Management:

- Set up data collection routines for real-time monitoring.
- Implement data storage and management to collect and store sensor data securely.

Remote Control and Actuation:

- Enable remote control of water distribution, valves, and pumps using actuators.
- Develop algorithms to optimize water distribution based on data analysis

Dashboard and User Interface:

- Create a user-friendly dashboard for stakeholders to visualize and interact with water usage data.
- Design the interface for desktop and mobile access.

Machine Learning and Analytics:

- Implement machine learning algorithms to predict water usage patterns and detect anomalies (e.g. leaks or water quality issues).
- Analyze historical data to optimize water management strategies.

Alerts and Notifications:

- Set up alerts and notifications for critical events, such as system failures or water quality issues.
- Notifications can be delivered via email, SMS, or mobile apps.

Security and Privacy:

- Implement robust security measures to protect data integrity and system access.
- Consider encryption, access control, and regular security audits.

Power Management:

Plan for efficient power management, especially for remote or battery-operated devices.

Environmental Sensors (Optional):

Integrate environmental sensors to monitor factors like weather, temperature, and humidity, whic can impact water management decisions.

Integration with Water Infrastructure:

Ensure your system can interface with existing water infrastructure, such as water treatment plants, distribution networks, and water meters.

Regulatory Compliance:

Ensure that your system complies with all relevant regulations and standards, including water quality and data privacy regulations.

Scalability:

Design your system to be scalable so that it can handle increased demands as your project grows.

Testing and Quality Assurance:

- Rigorously test your system to ensure reliability and accuracy.
- Set up a schedule for maintenance and updates.

Documentation and Training:

- Document your system for users, maintenance personnel, and any future development.
- Provide training as needed.

Public Awareness and Stakeholder Engagement:

Engage with the community and stakeholders to raise awareness about water conservation and the benefits of your smart water management system.

PYTHON SCRIPT:

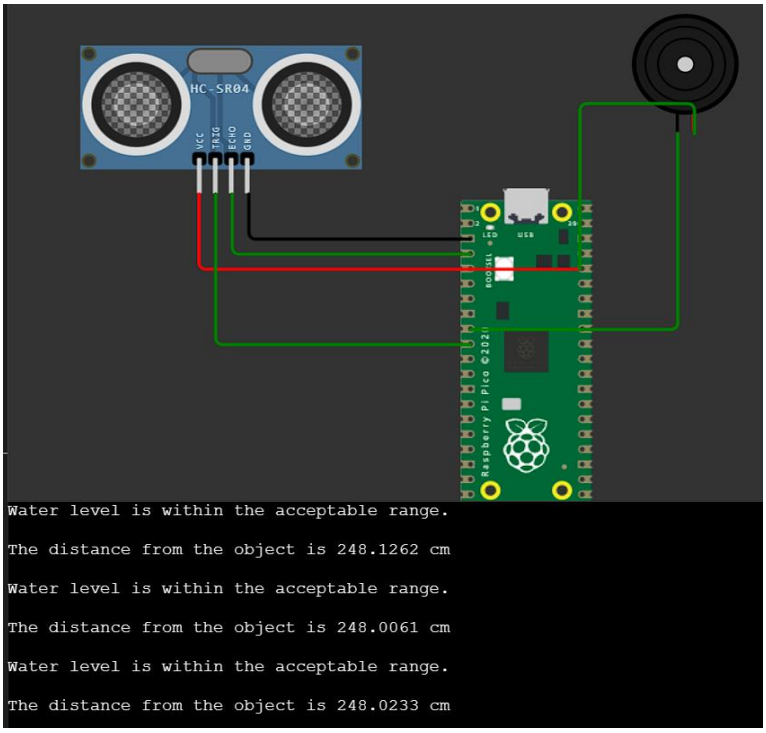
```
from machine import Pin
import utime

trigger = Pin(7, Pin.OUT)
echo = Pin(2, Pin.IN)

# Define water level thresholds
WATER_LEVEL_LOW = 100  # Adjust this value based on your setup
WATER_LEVEL_HIGH = 400  # Adjust this value based on your setup

# Define buzzer pin and configure it as an output
buzzer_pin = Pin(6, Pin.OUT)

# Define the watering pin and configure it as an output
watering_pin = Pin(8, Pin.OUT)
def ultra():
    trigger.low()
    utime.sleep_us(2)
    trigger.high()
    utime.sleep_us(5)
    trigger.low()
    while echo.value() == 0:
        signaloff = utime.ticks_us()
    while echo.value() == 1:
        signalon = utime.ticks_us()
    timepassed = signalon - signaloff
    distance = (timepassed * 0.0343) / 2
    return distance
```

```
def activate_buzzer():
    # Function to activate the buzzer
    buzzer_pin.on()
    utime.sleep(1)  # Buzzer on for 1 second
    buzzer_pin.off()

def start_watering():
    # Function to start watering
    watering_pin.on()
    print("\nWatering started.")
    activate_buzzer()  # Activate the buzzer when watering starts

def stop_watering():
    # Function to stop watering
    watering_pin.off()
    print("\nWatering stopped.")
    activate_buzzer()  # Activate the buzzer when watering stops

def check_water_level():
    distance = ultra()
    print("\nThe distance from the object is", distance, "cm")

    # Check the water level
    if distance < WATER_LEVEL_LOW:
        print("\nWater level is low. Refill the tank.")
        start_watering()  # Start watering when water level is low

    elif distance > WATER_LEVEL_HIGH:
        print("\nWater level is high. Tank is full.")
        stop_watering()  # Stop watering when water level is high

    else:
        print("\nWater level is within the acceptable range.")

while True:
    check_water_level()

    utime.sleep(1)
```

Diagram .json:


```
{
  "version": 1,
  "author": "Aafiya Farveen J 21UVA001",
  "editor": "wokwi",
  "parts": [
    {
      "type": "wokwi-pi-pico",
      "id": "pico",
      "top": 35.25,
      "left": 22.8,
      "attrs": { "env": "micropython-20230426-v1.20.0" }
    },
    {
      "type": "wokwi-hc-sr04",
      "id": "ultrasonic1",
      "top": -56.1,
      "left": -205.7,
      "attrs": { "distance": "246" }
    },
    {
      "type": "wokwi-buzzer",
      "id": "bz1",
      "top": -84,
      "left": 126.6,
      "attrs": { "volume": "0.1" }
    }
  ],
  "connections": [
    [ "ultrasonic1:VCC", "pico:3V3", "red", [ "v0" ] ],
    [ "ultrasonic1:GND", "pico:GND.1", "black", [ "v0" ] ],
    [ "ultrasonic1:TRIG", "pico:GP7", "green", [ "v0" ] ],
    [ "ultrasonic1:ECHO", "pico:GP2", "green", [ "v0" ] ],
    [ "bz1:1", "pico:GP6", "green", [ "v0" ] ],
    [ "bz1:2", "pico:3V3", "green", [ "v-19.2", "h-173.2" ] ]
  ],
  "dependencies": {}
}
```

OUTPUT:



SENSORS USED IN SMART WATER MANAGEMENT SYSTEM:

1. Flow Sensors: These sensors measure the flow rate of water in pipes and canals. They are crucial for monitoring water distribution and identifying irregularities or leaks.

2. Pressure Sensors: Pressure sensors help monitor the pressure in the water distribution system. Abnormal pressure levels can indicate issues like leaks or blockages.

3. Water Quality Sensors:

- pH Sensors
- Turbidity Sensors
- Dissolved Oxygen Sensors

4. Level Sensors: Level sensors are used to measure the water level in reservoirs, tanks, and open bodies of water. They help manage water storage and prevent overflow.

5. Temperature Sensors: Temperature sensors monitor the temperature of water in various parts of the water infrastructure. This information can be important for water quality control and optimizing energy use in water treatment processes.

6. Water Leak Detection Sensors: These sensors can detect leaks in water pipelines by monitoring changes in pressure, temperature, or acoustic characteristics of the pipe.

7. Water Meter Sensors: Smart water meters incorporate sensors to measure water usage and transmit data for billing and consumption analysis.

TECHNOLOGY USED IN SMART WATER MANAGEMENT SYSTEM:

1. IoT (Internet of Things) Sensors: IoT sensors are deployed in various parts of the water infrastructure, such as pipelines, reservoirs, and treatment plants, to collect real-time data on water quality, flow rates, pressure, and more. These sensors transmit data to a central system for analysis.
2. Remote Monitoring and Control: Remote monitoring and control systems enable water utilities to manage their infrastructure from a central location. This can include adjusting water flow, pressure, and treatment processes to meet demand or address issues in real time.
3. Leak Detection Systems: These systems use acoustic sensors to detect water leaks in pipelines. When a leak is detected, it can trigger alerts for immediate repair, reducing water loss and preventing damage to infrastructure.
4. Mobile Apps and Customer Portals: Utilities often provide customers with mobile apps and web portals that allow them to monitor their water usage, set conservation goals, and receive alerts about potential leaks.
5. Data Analytics and AI: Data analytics and artificial intelligence (AI) algorithms are used to process and analyze the data collected by sensors. AI can predict maintenance needs, detect leaks, and optimize water distribution by identifying usage patterns.
6. SCADA (Supervisory Control and Data Acquisition) Systems: SCADA systems provide real-time control and monitoring of water infrastructure. They allow operators to remotely monitor and control equipment, valves, and pumps, and respond to issues promptly.
7. Smart Meters: Smart water meters provide accurate and real-time data on water consumption in homes and businesses. This data helps customers and utilities better manage water use and billing.
8. Water Quality Monitoring: Advanced sensors are used to continuously monitor water quality parameters such as pH, turbidity, chlorine levels, and contaminants. This ensures that the water supply meets regulatory and safety standards

CAMERA USED IN SMART WATER MANAGEMENT SYSTEM:

1. Underwater Cameras: Underwater cameras may be used for monitoring and inspecting underwater infrastructure, such as dams, bridges, or underwater pipelines. They can provide valuable visual data for maintenance and assessment.
2. Water Quality Imaging: Advanced imaging systems, such as hyperspectral or multispectral cameras, can be used to capture images of water bodies and analyze water quality parameters, including color, turbidity, and the presence of algae or contaminants.
3. Security and Surveillance Cameras: Security cameras may be installed in and around water treatment facilities and reservoirs to monitor security and access control. These cameras can also help deter vandalism and unauthorized entry.