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Analysis of Water Management in Overhead Tanks (OHT) using Heavy Duty Motors with Integrated Water Supply System

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Abstract: *Efficient and sustainable water management is critical in both urban and rural environments. This project presents an integrated smart water supply system for Overhead Tanks (OHTs), combining heavy-duty motor automation with real- time water quality and level monitoring. The core of the system leverages an ultrasonic sensor to continuously measure the water level in the tank, preventing overflow through automated motor control. When the water level falls below a predefined threshold, a relay-activated motor is triggered to refill the tank. To ensure the supplied water is safe for use, the system incorporates a Total Dissolved Solids (TDS) sensor for assessing water quality and a turbidity sensor to evaluate its clarity.*

These sensor readings are displayed on an LCD screen for easy local monitoring, while a buzzer alerts users when the tank reaches its full capacity, thereby reducing water wastage. The integration of IoT technology further enhances system functionality by enabling cloud-based monitoring and control. Users can remotely access real-time data on water level, quality, and turbidity via an IoT platform, allowing for timely interventions and data-driven decision-making. This reduces the need for manual oversight, promotes water conservation, and ensures a consistent supply of clean water. The proposed system offers a scalable and intelligent solution for water resource management, contributing to public health and sustainable development goals.

Keywords: Overhead Water Tanks (OHT)Water Management Systems, Heavy Duty Water Pumps, Integrated Water Supply, Motorized Water Control, Smart Water Distribution, Water Usage Optimization, Water Level Monitoring, Automated Water Supply, Energy-Efficient Pumping, Urban Water Infrastructure, Smart Utility Systems, Water Conservation Techniques, Pumping System Analysis, IoT in Water Management

I. INTRODUCTION

Efficient water management is a critical aspect of urban infrastructure, particularly in regions facing water scarcity or inconsistent supply. Overhead tanks (OHTs) play a significant role in storing and regulating water for domestic, commercial, and industrial use. However, conventional water management systems often face challenges such as energy inefficiency, uncontrolled water overflow, irregular distribution, and excessive reliance on manual monitoring.

To address these issues, the integration of heavy-duty motors and automated control mechanisms has emerged as a practical solution. By employing robust motorized pumping systems combined with an integrated water supply design, it becomes possible to optimize the flow, minimize wastage, and ensure timely refilling of tanks based on demand and consumption patterns. This paper presents an analytical approach to water management in OHTs, focusing on the performance, efficiency, and reliability of heavy-duty motors in conjunction with intelligent supply control systems.

Through systematic analysis and performance evaluation, this study aims to highlight the potential for sustainable and automated water management practices, contributing to improved utility operations and resource conservation.

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II. LITERATURE REVIEW

1) Farmanullah Jan, Nasro Min-Allah, Dilek Düştegör IoT-Based Smart Water Quality Monitoring: Recent Techniques, Trends and Challenges for Domestic Applications -2021

IoT-based smart water quality monitoring systems are growing rapidly, using low-cost microcontrollers like Arduino and ESP32 paired with sensors to track pH, turbidity, TDS, and temperature. Data is sent to cloud platforms or mobile apps for real-time monitoring and anomaly detection. Despite challenges like sensor calibration, data security, and connectivity, these systems offer a sustainable solution for ensuring clean, safe water in households. Future advancements focus on energy efficiency, self-calibrating sensors, and integrating machine learning for smarter, more autonomous systems. However, scalability and maintaining accuracy in diverse environments remain hurdles.

2) G.S. Nandini, P. Bhuvaneshwari, S. Gowthami, S. Elango IoT Based Smart Water Management System with Machine Learning-2023

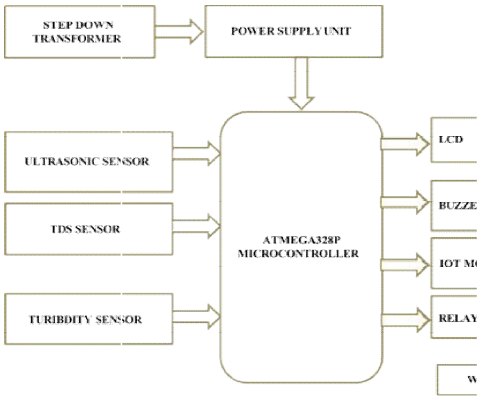
The IoT-based Smart Water Management System with Machine Learning is an advanced solution that integrates IoT sensors with cloud platforms to monitor key water parameters like water level, pH, turbidity, temperature, and TDS. The system continuously collects data and sends it to a cloud for analysis. By integrating Machine Learning (ML) algorithms, it predicts water consumption patterns, detects anomalies, and provides insights for efficient management. This helps reduce water wastage, improve distribution efficiency, and ensure clean water availability.

The system also features an automatic control mechanism that regulates water flow based on real-time data, preventing overflow and contamination. Users receive alerts via mobile apps or dashboards for quick decision-making. The system minimizes manual intervention, reduces operational costs, and supports sustainable water use, making it ideal for both urban and rural settings. Ultimately, it contributes to smarter, more efficient water management and supports smart city initiatives.

3) : N. Geetha IoT Based Smart Water Quality Monitoring System 2016.

An IoT-based Smart Water Quality Monitoring System is a cutting-edge solution designed to enhance the management and safety of water resources through continuous monitoring and real-time data collection. This system leverages Internet of Things (IoT) technology, integrating various sensors such as pH, turbidity, Total Dissolved Solids (TDS), temperature, and other water quality parameters. By using these sensors, the system provides accurate and immediate insights into the water quality, ensuring it meets the necessary standards for health and safety. The system typically involves wireless communication, allowing data to be transmitted to a cloud-based platform where it can be monitored remotely. This not only reduces the need for manual intervention but also enables stakeholders, including municipal authorities or water treatment facilities, to take immediate action in case of any deviation from the optimalwater quality levels.

III. BLOCK DIAGRAM



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IV.HARDWARE COMPONENTS

1. Arduino UNO

• Type: Microcontroller board based on ATmega328P

• Role: Acts as the brain of the system. It reads inputs from switches and the ultrasonic sensor, processes them, and controls

FEATURE

Microcontroller: ATmega328P
Operating voltage: 5V
Input voltage: 7-12V
Flash memory: 32KB
SRAM: 2KB
EEPROM: 1KB

Fig 1 Arduino.

2. IoT Module (ESP8266)

• Type: Communication Module

• Role: Sends real-time data to Blynk IoT platform

Fig 2 IoT Module (ESP8266)

FEATURES:
Wi-Fi enabled, remote monitoring, compact size

3. 16x2 LCD Display

• Type: Character LCD screen

• Role: Shows SOC, voltage, current, and temperature

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• Connected via: Digital pins on Arduino (usually through I2C module or directly)
FEATURES: Real-time display, user-friendly interface

Fig 3 LCD Display.

4. 7812 Voltage Regulator
• Type: linear regulation in electrical cicuits
• Role: power source

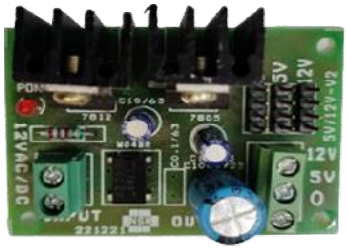

Fig 4 voltage controller

Features: stable, linear, efficient, output, protected

5. Relay Board
• Type: Electromechanical switch
• Role: Disconnects charger to prevent overcharging

Fig 5 Relay

FEATURES
Electrically controlled, high current switching

6. TURBIDITY SENSOR
• Type: Sensor
• Role: measures the cloudiness or clarity of water
• Features: Real-time monitorning, wide detected range.

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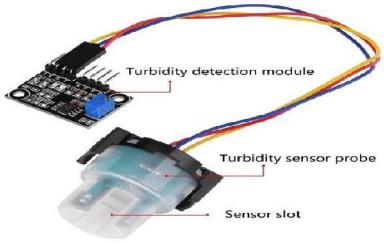

Fig 6 turbidity sensor

7. Ultrasonic sensor

• Type: Sensor
• Role : water level detection in oht tank, obstacle detection
• Features: fast response time, high accuracy,wide sensing range

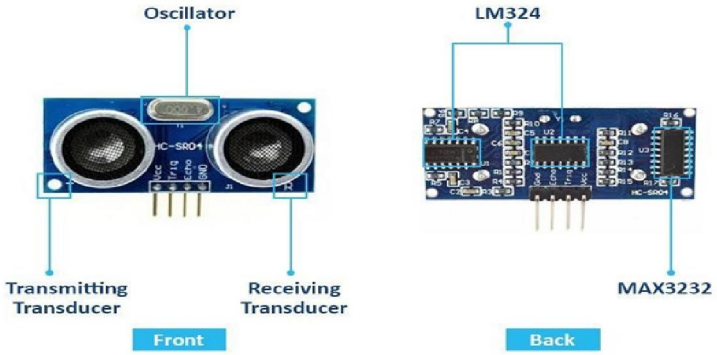

Fig 7 ultrasonic sensor

8. WATER MOTOR 6-9v (submersible pump)

• Type: submersible pump
• Role: lifting water, filling water for oht tanks
• Features: high suction and delivery head

Fig 8 water motor

9. BUZZER (sound- tone)

• Type: aleart Interface
• Role: aleart purpose indicator
• Features: produce tone beep aleart

Fig 8 buzzer

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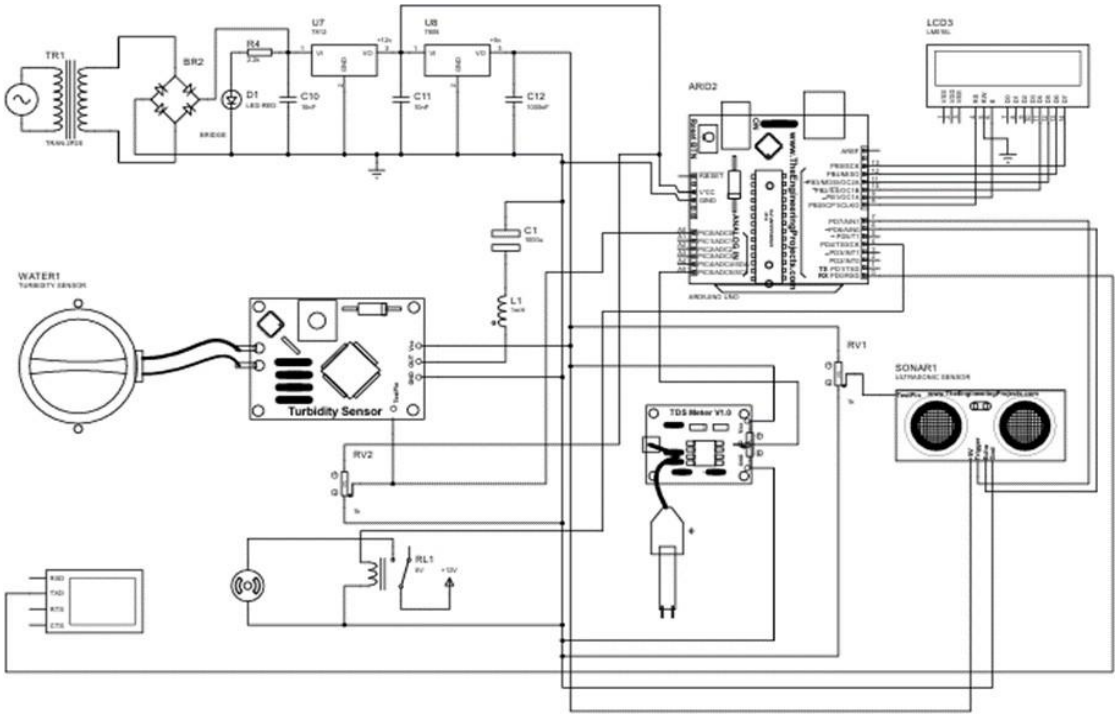
V. CIRCUIT DIAGRAM



CIRCUIT DIAGRAM EXPLANATION

This circuit is a water quality monitoring system built around an Arduino Uno. It includes a power supply section that converts AC to regulated DC voltages to power the components. The system uses a turbidity sensor to measure water clarity, a TDS sensor to assess total dissolved solids, and an ultrasonic sensor to measure water level. The Arduino processes data from these sensors and displays the results on an LCD screen. If water quality drops below set thresholds, a buzzer sounds an alert, and a relay can be triggered to control external devices like a pump or valve. Potentiometers are used for sensor calibration or setting alert levels

PROPOSED SYSTEM

The proposed water management system automates the operation of overhead water tanks using smart sensors, a heavy-duty motor, and IoT technology. An ultrasonic sensor monitors water levels to control motor operation, while TDS and turbidity sensors ensure water quality. The system displays real-time data on an LCD and alerts users with a buzzer when the tank is full. IoT integration enables remote monitoring, data logging, and alerts through cloud connectivity, improving efficiency, reducing water wastage, and ensuring safe water supply. This scalable solution is suitable for both domestic and large-scale applications.

SOFTWARE MODULE REQUIRED

1.Arduino IDE

- Used for writing and uploading the code to the Arduino UNO.
- Programming language: C++

2.Proteus Design Suite

- Used for simulating the entire circuit before hardware implementation.
- You can test sensors, LCD, and Arduino connections virtually.

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VI. APPLICATIONS

1. Residential Buildings: Automated water level control and quality monitoring for household tanks.
2. Apartments and Housing Societies: Centralized management of multiple OHTs with remote monitoring and alerts.
3. Industrial Facilities: Efficient water usage and quality control in manufacturing and processing plants.
4. Educational Institutions: Ensures consistent water supply and safety in schools, colleges, and universities.
5. Hospitals and Healthcare Centers: Maintains high-quality water standards critical for hygiene and patient care.
6. Municipal Water Supply Systems: Scalable solution for urban and rural water distribution infrastructure.
7. Agricultural Irrigation Systems: Monitors water levels and quality for efficient crop irrigation.

VII. ADVANTAGES

- Automated water control reduces manual effort.
- Real-time monitoring of water level and quality.
- Prevents overflow and water wastage.
- Ensures safe, clean water supply through quality sensors.
- IoT integration enables remote access and alerts.
- Data logging helps analyze usage trends.
- Scalable and adaptable for various applications.
- Improves efficiency and reliability in water management.

VIII. CONCLUSION

In conclusion, the proposed water management system offers an efficient, reliable, and automated solution for monitoring and controlling water levels and quality in overhead tanks. By integrating heavy-duty motors, smart sensors, and IoT technology, the system ensures optimal water usage, reduces wastage, and provides safe, clean water. Its remote monitoring capability and scalability make it suitable for a wide range of applications, contributing to sustainable water resource management.

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