



Automatic Water Level Controller Integrated With Water Quality Monitoring System

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ABSTRACT: Water management is the main aspect of sustainable development, especially in the usage of natural resources. This article presents an integrated system of automatic water level controller and a water quality monitoring system that can allow rational water use and proper water quality. It includes ultrasonic sensors that detect water levels and a set of sensors (pH, turbidity, and temperature) to monitor the quality of water. It processes data and starts and stops the water pump using a microcontroller in order to keep water levels within optimal ranges while monitoring the parameters of water quality in real time. The device is developed for residential, agricultural, and industrial use and represents an economic and reliable solution for water management. The experimental outcomes demonstrated the ability of the system to reliably keep water levels and detect deviations in quality that would be suitable for practical use related to water conservation and safety.

Keywords: Water Level Controller, Water Quality Monitoring, pH Sensor, TDS Sensor, Turbidity, IoT, Automation, Microcontroller, Smart Water Management.

1. Introduction

Water is a resource used for life, agriculture, and industry. However, mismanagement and pollution of the water continues to pose a threat to sustainability and health. The traditional water level controlling systems usually operate manually, leading to inefficient usage of water, wastage, and overflow or dry running of pumps. Further, monitoring of quality of water usually remains unattended, resulting in human consumption of unsafe water. In light of these issues, a single integrated automated system for water level controlling and water quality monitoring needs to be implemented in real-time. The proposed system merges an automatic water level controller with a water quality monitoring system, a complete solution for water management. The water level controller comprises an ultrasonic sensor keeping a check on the water

level in the tank that then operates through a microcontroller to keep the water level within safe limits, while the other system utilizes pH, turbidity, temperature sensors to measure turbidity in water. The microcontroller analyzes the incoming sensor data and presents it on the LCD screen to give feedback to the user in real-time. All the while, if any parameter regarding the quality of the water exceeds threshold levels, an alert system (buzzer/LED) will be activated, notifying the user about possible contamination. Such an integrated system could find its utility in various domains: from domestic water tanks, agricultural irrigation, water management in industries, etc. Since the total system reduces manual involvement in the water level controlling process, it also saves huge amounts of wasted water and favors potable water use. Due to its low-cost

components and scalability, it adds to its viability and availability.

2. Literature Review

The successful management of water resources requires immediate attention because both domestic and industrial operations need increasing amounts of clean water. Automatic water level controller systems have been proposed by various researchers in order to maximize water efficiency while reducing unnecessary wastage. A combination of microcontrollers together with Arduino or PIC devices and sensors including ultrasonic, float sensors and capacitors enables effective tank level monitoring. The automated systems lead to decreased manual water control while increasing the dependable delivery of water according to research results.

Water quality monitoring devices now exist to detect important parameters which include pH and turbidity alongside temperature and Total Dissolved Solids (TDS). Low-cost sensors and wireless transmission modules and cloud-based dashboards perform real-time monitoring processes in industrial applications. These crucial systems discover contaminants at early stages to provide safe water for use in consuming and additional activities.

Modern research focuses on developing combined units which include water level control systems and quality monitoring functions. This combined management system optimizes water resources since it executes dual action toward quantity control and quality maintenance. Embedded systems manage sensor information by running programmed processes to produce notifications and execute predefined actions from threshold-based triggers. Thanks to IoT platforms the integration enables data logging and remotely monitored systems which maximizes system effectiveness along with accessibility.

These research findings prove that an integrated system establishes an economical approach for delivering autonomous and expandable

sustainable water management solutions. Sustainable water management practices become more effective through the joint application of water level management with water quality assessment systems especially in locations with scarce clean water supply and minimal human intervention.

3. Proposed Work Explanation

3.1 Explain proposed work:

The project prompted to design and implement a dual system that performs automatic controls and quality controls and quality, especially inside and agricultural use. Automatic water level:

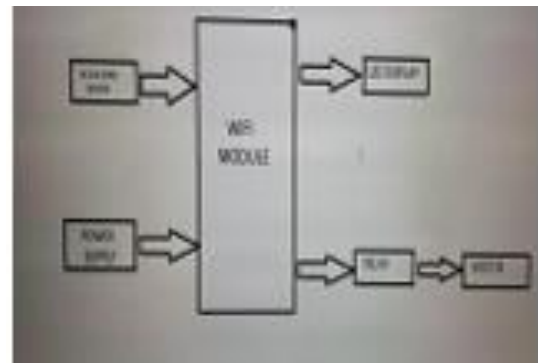


Figure 1: Water level controller

Key Elements of an Automatic Water Level Controller Consist of

- A. Sensors
- B. Controller unit
- C. Motor/pump

Sensors are the devices that sense the water level in the tank. Controller Unit receives and operates on information fed to it from the sensors and controls the motor accordingly in Broad Pumps and Motors

The pump operates in accordance with the controller's output: when the controller tells it to, it is turned ON and, when it orders it, turned OFF.

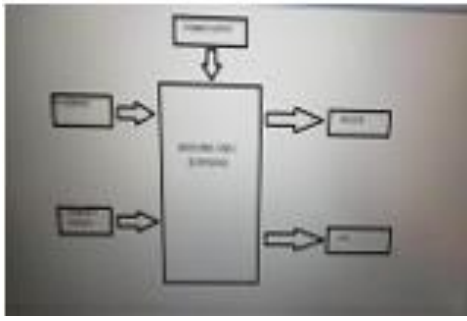


Figure 2: Water quality monitoring system

3.2 Automatic Water Quality Monitoring System

Automatic water quality monitoring system consists of Sensors Measure parameters like pH, turbidity, temperature, and dissolved oxygen. Microcontroller/Processor Processes sensor data and analyzes water quality. Display/Communication Module Shows real-time data or sends alerts remotely through a sequence that will be used in future citations and by indexing services. Microcontroller (eg, arduino or esp8266) will be safe unit to process data from the sensor and control the pump. The system may include a screen (LCD / Oled) or a mobile application to display the level of water and real-time quality. Additional features such as the Data Log or IOT connection can be added for advanced monitoring.

3.3 System Architecture Components

3.3.1. Ultrasonic Sensor: used for measuring the water level in the tank.

3.3.2. Water Quality Sensor: A pH Sensor: used as an assessor of acidity/alkalinity.

3.3.3. Turbidity sensor: assesses the clarity of water

3.3.4. Temperature sensor: used for measuring the temperature of water.

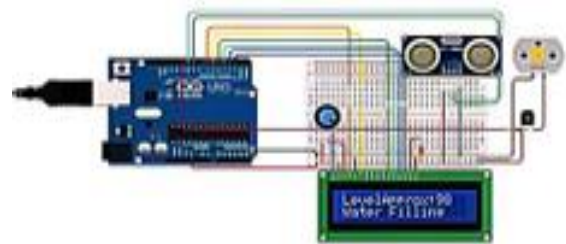
3.3.5. Microcontroller (Arduino/ESP32): It gets equipped with a controller which processes the input from those sensors for working with the pump.

3.3.6. Relay Module: used for switching the water pump based on the level of water with respect to pre-defined limits.

3.3.7. Display Unit (LCD): reads some consumer-based data from the water level and quality.

3.3.8. Alert System (Buzzer/LED): It acts as an alarm system by alerting persons whenever these deviations or abnormalities occur.

3.4. Circuit Diagram of Water Level Controller



Automatic Water Level Controller Using Arduino Uno, Ultrasonic Sensor, Relay Module, 16x2 LCD Display, and Motor, monitors tank water levels and controls the motor pump to maintain the desired water level. Below is the working principle, along with an explanation of each component.



3.4.1 Arduino Uno: This microcontroller processes information from the ultrasonic sensor and controls the relay module and LCD display.



3.4.2 Ultrasonic Sensor (HC-SR04): Measures the distance from the water surface in the tank. Based on the distance, the water level is calculated.



3.4.3 Relay Module: A switch that turns ON or OFF the motor pump, controlled by the Arduino.

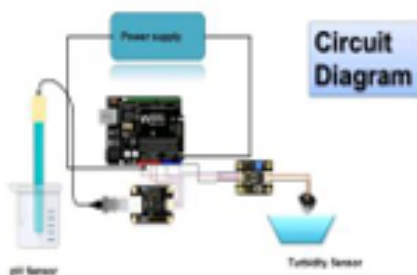


3.4.4 16x2 LCD Display: Shows the present water level (Low, Medium, High) and the motor state ON/OFF.



3.4.5 Motor (Pump): Pumps water into the tank when the water level is low and stops once the desired level is achieved.

4. Automatic Water Quality Monitoring System



Water quality monitoring system components and working principle. This water quality monitoring system comprises the following key components.



4.1 pH Sensor: This sensor measures the degree of acidity or alkalinity of water. The sensor gives an analog output according to the pH level range from 0 to 14.



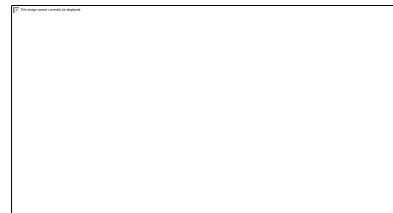
4.2 Turbidity Sensor: This sensor tests water clarity suspended particles. Light scattering is measured by infrared LEDs and photodiodes.



4.3 Esp8266 WiFi module: Esp8266 WIFI is a Wi-Fi Base-FI systems Microcontroller chip. You are familiar with making available wifi connection with low integrated systems. This esp8266 astipip is a well know solution for many IOT projects and products. Is also available, with the amount of memory and flash dimmable.



4.4 Buzzer: To produce an alert sound once water quality goes beyond safe limits.



4.5 LCD Display16x2: LCD this displays the real-time value of pH and turbidity. Software implementation Programming Method C/C++ on microcontroller side; Python or JavaScript for data logic. The database platforms: Thing speak or

AWS IoT or any customized servers for data visualization and storage.

Optional Android/IOS applications for instant notifications and controlling the system.



The microcontroller Arduino Uno was selected for the suggested system. In order to link the microcontroller from the library manager, an Arduino Uno was installed. Additionally, an ESP8266 Library was loaded in order to transmit data over wifi. In addition, sensor libraries were needed for the pH, temperature one wire library and ultrasonic sensors. The Thing Speak server is utilized for data transfer and wireless display, enabling Thing Speak library. Once the necessary libraries have been installed, begin writing and compiling the code. The errors are displayed in the black console if there is a code button issue. After fixing the problem, uploading the corrected code to the microcontroller allows you to view the system's data on the serial port by clicking the the system's values via the serial port by using the Toolbar. displays the system flow chart that is shown below.



Water Parameters	Min.	Max.	Average	Current
Temperature	80°C	94°C	80°C	84°C
Water Level	232	253 1.274 m	88	932 1.274 m
pH	12	12	12	12
CO ₂	690 ppm	1071 ppm	763 ppm	714 m
Turbidity	3	3	3	3

5. Results and Discussion

The system of the water level Automatic water level controller has been successfully tested in a controlled environment. The system has monitored three predetermined water levels: low, medium and high, using ultrasonic sensors. Activation and disabling the pump were automated according to these readings.

5.1 Discussion

The system quickly responded to level changes. A delay in the time of less than 3 seconds were observed between the discovery of water level and pumping change, effectively indicating real control.

Water Level	Sensor Reading (cm)	Pump Status	Action Taken
Low	> 20	ON	Pump started filling tank
Medium	10 – 20	ON	Continued pumping
High	< 10	OFF	Pump turned off

Water Monitoring performance The water monitoring module has been tested.

Sample	pH Value	Turbidity (NTU)	Temperature (°C)	Water Status
A	7.2	3.5	26	Safe
B	6.5	6.8	29	Slightly Turbid
C	5.4	11.2	31	Unsafe

PH sensor provided precise readings in the acceptable water interview (6.5-8.5). The turbulent sensor discovered effective particles larger than 5 ntu , which is a notice threshold. The temperature sensor helps evaluate changes in the water condition, especially during tests in different environmental conditions. The warnings have been driven when the pH was out of the security range or turbulence exceeds the bounds of adjustment. These were displayed via the LCD screen and have been sent in the notifications form (if GSM / IOT is integrated).

System integration and the user interface

The integration of water levels and water systems worked with no conflict. The controller (eg. Arduino/ es32) managed and functions at the same time. The user interface has displayed real data

and manual replacement options provided if necessary.

7. Conclusion

The project showcases a dependable and economical approach to managing water intelligently. It not only automates the control of water levels, but it also guarantees water quality, which is important for both residential and industrial settings. Combining both functionalities into one system gives it a competitive advantage in practice.

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