Design and Development of Automatic Quality Domestic Water Distribution and Wastage Reduction Management System

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Abstract. The consequence of the project is that it is possible to minimize unnecessary consumption of water and provide water of good quality. This will eliminate additional health conditions. Recent days have raised the availability of polluted water due to the irresponsibility of staff or the collapse of pipes. However to prevent such cases, such automated systems will help to achieve the best water quality. Another big issue that can be minimized once this project is successfully completed is undesirable water pollution. By automatically shutting down the inlet tube once the tank reaches the full volume large amounts of water can be saved. As of now the water is just shut down on time. This can be stopped. The tank can be cleaned periodically via the automated tank cleaning system with echo enzymes, which in most locations is not properly accomplished. Bacteria and other germs can also be killed automatically by adding organic chlorine when needed. This is more effective than human work, since human beings add chlorine. They just add randomly, but this can be avoided when automated. The system of rationing implemented in this project would help people get the same amount of water. And robbery may also be minimized. We can also implement a system to buy water online by means of which people can buy water when they need the excess. All data, such as flow rate, pH, can be obtained from each house with GSM technology. This project will help to build a new, intelligent village and help people to access good quality water. In addition, implementation can be carried out on the basis of the specifications.

Key Words: Water Management System, SCADA, Hybrid Power, Domestic Water Distribution

1. INTRODUCTION

Level sensors detect fluids and other fluids, granular materials that may also include slurries and powders with an upper free surface. The calculated material may be in a jar or in its natural shape. The calculation of the level may be constant or point values. In a given range, continuous levels calculate levels and decide exact quantity of the substance in a certain area, while point level sensors indicate only if the substance is above or below the sensing point. The latter usually detect extremely high or low levels. The transmitter level electrical signal (4-20 mA or 0-24 V DC) is given for the input of the relay electromechanical actuator. Whenever the water automatically closes the valve to the highest level and retains water level via the programming of the PID controller in the embedded controller, and the output of the entire device is transmitted through the GSM technology to the receiver end (operator segment). This helps us to stop wasting water due to overflow.
2. TO IDENTIFY THE WATER THEFT AND MAKE SURE THAT EVERYONE GETS EQUAL AMOUNT OF WATER.

A flow meter will be attached to the outlet pipe of the storage tank. A flow meter will also be attached in every end that is to every pipe that enters the house. A flow meter is a device used to measure the flow rate or quantity of a gas or liquid moving through a pipe. Based on the pressure head difference the volumetric flow rate can be calculated and which is further analyzed by mathematical calculation and programmed in microcontroller unit. Whenever the flow exist its nominal free pre specified flow rate, the solenoid valve automatically kept closed. When the flow rate of the particular flow meter exceeds the nominal value then valve will be closed and the water theft can be identified. So the message from that flow meter will be sent to the receiver section (operator) and necessary action can be taken. So when someone uses motors to suck water it can be easily identified.

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**Figure 3** Ultrasonic Flow Meter

\[
u(t) = K_p e(t) + K_i \int_0^t e(t) dt + K_d \frac{de(t)}{dt} \tag{1}
\]

\[U(t) \text{ PID} = K_p E(t) + K_i E(t) + K_d \frac{dE(t)}{dt} \tag{2}\]

Where,

- \(K_p\) = Proportional gain
- \(K_i\) = Integral gain
- \(K_d\) = Derivative gain
- \(E(t)\) = Setpoint - Process variable = Error
- \(U(t)\) = Controller output

4. **TO INTRODUCE A METHOD OF WATER PURCHASING WHENEVER EXCESS AMOUNT OF WATER IS NEEDED (WATER RATIONING)**

This is an interesting idea. By implementing this method we are able to purchase water whenever excess amount is required. Actually the main aim of this objective is to supply equal amount of water to all the houses. So when the amount of water supplied reaches the range the valve closes automatically. And if there is any function in the habitats home or they require excess amount of water they can book priorly. So with the help of GSM the reference value of the flow meter will be changed for the particular house as per the amount paid. The valve again closes when the flow meter value updated is reached. This method helps in supplying equal amount of water to everyone in that particular area. Figure 4 Indicats the “How California Water Rationing Will Work”, it is mentioned in the www. https://www.reddit.com/
5. TO DESIGN AN AUTOMATIC TANK CLEANER IN ORDER TO CLEAN THE TANK AUTOMATICALLY ON THE REGULAR BASIS.

Water being stored for a long period of time might develop microbes, bacteria and other living microscopic organisms thus contaminating drinking water and making it unfit for drinking purpose. In order to avoid this, regular washing and maintenance of storage tank is of prime importance. Sprinklers supported with motors and Arduino boards are being used to automate the process. Sequence of steps that takes place is as follows:

- Empty the water tank by closing the inlet valve and opening the outlet valve.
- Close the Outlet Valve and open the safety wash valve to ensure that the tank is empty.
- Close the safety wash valve and power the motor.
- Echo enzymes based cleaning liquid is sprayed via sprinkler arrangement kept along the top, side and bottom of the storage tank. (for a period of 5 minutes)
- After 5 minutes the sprinkler valve sprays water for a period of time. (for a period of 5 minutes) Allow the mixture to react for 15 minutes.
- Open the safety wash valve so that the dirty water flows out of the storage tank.
- Close the safety wash valve and again allow the sprinkler to spray water to ensure no dirt is present.
- Open the safety wash valve.
- Open the inlet valve and start distribution once the tank reaches the preset limit.
- Timer setup is controlled by using Arduino board.

Figure 4 Water Rationing System

Figure 5 Water Rationing System Block Diagram
6. TO DESIGN AUTOMATIC ORGANIC CHLORINATION IN THE TANK SO THAT NOMINAL AMOUNT OF CHLORINE WILL BE ADDED AUTOMATICALLY

Water chlorination is the process of adding chlorine (Cl₂) or hypochlorite to water. This method is used to kill certain bacteria and other microbes in tap water. In particular, chlorination is used to prevent the spread of waterborne diseases such as cholera, dysentery, and typhoid. In order to carry out the process the amount of chlorine already present in the water is monitored using a chlorine analyzer. The average amount of chlorine that has to be presented in water is about 0.2–1 mg/litre. In this project organic chlorine is stored above the water storage tank from which it will be dispensed into the water stored inside the tank. The amount of organic chlorine that has to be dispensed is controlled by a valve to which a preset value of command is issued from the Arduino board. The preset value is the difference of available organic chlorine content present in the water and the amount of organic chlorine permitted to exist in a drinking water. Before water being distributed for consumption, the value of organic chlorine present is again calculated using analyzer to ensure safety. Timing and control of valves are done by using Arduino board. To detect the leakage of water in the pipe and avoid the water wastage.

7. TO MEASURE THE QUALITY OF WATER THAT IS DISTRIBUTED AND AVOIDS THE SUPPLY OF CONTAMINATED WATER

The contaminated water can be measured using pH meter. A pH meter is an instrument which measures the hydrogen-ion activity present in water-based solutions, indicating its alkalinity or acidity expressed as pH. The pH meter measures the difference in the electrical potential between a pH electrode value and a reference value given. The difference in electrical potential relates to the acidity or pH of the solution. These pH meters will be placed in each house. So if any change in the pH value is found the actuators will be activated and the valve will be closed in order to stop the supply. And the message will be sent to the operator to check immediately. As cleaning and chlorination is done in the tank in regular basis and pH is also checked in the tank. So the problem will be solved mostly when the contaminated water mix with the supply if any other cracks in pipe. So we can find which valve is closed and the problem in that pipe can be easily solved.

![Figure 6 Structure of Water Distribution System](image)

As flow meters are placed in outlet of the tank and in every house we can easily find the leakage. Summing the flow values of measured in each house and finding the difference between the
outlet values of tank with the total flow value of each house we can find leakage. If difference value is zero then it shows that there is no leakage.

8. RESULTS AND DISCUSSION

Reports underlining the tabular or graphical evolution of the selected parameters by using the database and/or archive data and by showing the data on a screen or a printer that enables users to complete/modify the information. This allows the selection of a list of parameters and specifies the channel for visualization and the respective time period for selecting year, month, day and hour. A complex monitoring and control framework for water supply parameters, implemented in Craiova, is the SCADA system presented in the paper.

The monitoring and control system enforces the receiver with an efficient functioning instrument that enables:

- Efficiency growth in the operation of pumping stations;
- Monitor pumps and reduction of energy consumption;
- Efficiency standards and changes in water quality;
- Continuous water supply service for the population;
- Continuous real-time tracking of the state of technical and energy usage parameters;
- User support for technical research and post-analysis development;
- To provide details on the factors of judgments for optimal decision making;
- Assuring the appropriate management IT flows.

![Figure 7 Water level with respect to time](image)

The automation in the water delivery system ensures that water is not wasted and time is reduced. We may also stop water theft in the pipelines altogether. But people will get the same amount of water. This is what we are talking about. The device is excellent and economical to avoid theft of drinking water.
The system becomes more efficient and stable with the use of PLC and SCADA. It offers improved water delivery network system service. SCADA offers a real-time switch from the desk of the operator into the system. Owing to the acidic nature of the water, corrosion of the water carrying pipe can be avoided. Water is saved when excess flow is observed. Water delivery system automation reduces waste water. The automation system ensures continuous water flow by the set stage. This project is automatic so that much human power is minimized.

9. CONCLUSION
A SCADA model is developed for the fluid level monitoring and transfer system used to track and regulate the fluid flow effectively online by regularizing various set points. PLC-based adaptive controls improve the performance remotely through the SCADA system from experimental results. The experimental study reveals that the SCADA system based on PLC conducts precise process operations and operation speeds much more quickly than the manual system. Automation-based control system offers equal transient response with minimal error indices of 0.92 percent compared to the manual system. Thus the overall performance of the automation system increased the PLC automation controller's operating efficiency in comparison with the manual system. In addition, the PLC automation system provides appropriate control action which prevents the occurrence of major risk factors such as flame retardant blasts in the long-distance oil transmission system.

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