RESEARCH ARTICLE

DOI: 10.34256/bsr2019

BULLETIN OF SCIENTIFIC RESEARCH

Metro Water Distribution System and Leakage Detection

Esha S Kumar [a,*], S. Pooja [a], M. Sivapriya [a], A. Sowndhariya [a], A. Alice Linsie [a]

[a] Department of Electronics and Communication Engineering, SRM Institute of Science and Technology Chennai, Tamil Nadu, India.

* Corresponding Author: eshaskumarecesrm@gmail.com DOI: https://doi.org/10.34256/bsr2019

Received: 02-03-2020
Accepted: 27-04-2020

Abstract: In the current scenario there is an increasing growth in the residential areas which in turn leads to larger population. Nowadays there has been a huge water scarcity problem across, there arises the need for adequate water distribution to all the areas and prevention of water leakage as well. This proposed system of water distribution and leakage detection system based on PLC and SCADA software is designed to allocate water as per requirement depending on the number of members residing in an area. This PLC based automated system using Embedded controller is already pre-programmed to do the operations and results are shown in ladder diagram using Pico soft software. A threshold is set for each area and the water is distributed from the main storage tank to other subsequent tanks. The water supplied is measured with the help of flow sensors and solenoid valves are used for automatic opening and closing of valves. PLC is used to control the distribution of water and SCADA is one of the emerging technologies which is used for complete monitoring.

Keywords: PLC unit, Solenoid valve, Float meter, Leakage sensor, SCADA, RS323 communication.

I. Introduction

The many issues related with water has been an ongoing theme in the civilizations due to rapidly growing cities and our increasingly modern methods and techniques. One such issue is water scarcity, which has caused the biggest crises in society. This problem can be prepared for and almost avoided, using proper planning, which this project aims to do with the help of modern technology. This project proposes a method for water supply management, which will help resolve shortage issues occurring due to wastage of water.

With the primitive methods being used now, there are many vulnerabilities that cause water loss and result in the management system being ineffective. Also, there is considerable usage of manpower which will become unnecessary with the implementation of this project. Current system, which is operated manually, does not have provisions for leakage detection. It also does not prevent theft of water with illegal pipe connections. All the control is manually managed, and hence is not completely reliable and also is a waste of manpower.

The proposed system completely automates the water management system, also providing leakage detection. It uses modern technology such as PLC and SCADA with which the water supply can be completely automated and efficiently managed. There is also a leakage detection feature, which pinpoints the location

of leakages. The outflow of water is monitored continuously and real time data can be used to detect theft.

II. Overview of the System

A. Existing System

The existing system is primitive in the aspect that all operations - such as opening and closing of valves - are done manually. Leakages cannot be detected even in the era of such technological advancements. Theft of water is very easy and may go unnoticed due to the absence of real time monitoring. There are no methods to monitor the usage of water for each unit.

B. Proposed System

The proposed system has the following features:

- Uses PLC and SCADA hence automating the process completely.
- No usage of manpower to open and close valves.
- Limit for water consumption fixed for each unit, preventing over usage or wastage.
- Leakage detection is possible, pinpointing the area of leakage.
- Water theft can be easily detected due to availability of data, thereby easily noticing discrepancies.

This proposed system is used to distribute water to the areas depending on their requirements so that everyone will receive the stipulated amount of water in account with number of people residing in an area. A threshold is set for each area and the water is distributed from the main storage tank to other subsequent tanks. The water supplied is measured with the help of flow sensors and solenoid valves are used for automatic opening and closing of valves. This will be the result of our proposed system.

III. Components in the Design

A. Programmable Logic Controller (PLC)

Programmable logic controller (PLC) is a solid-state device which controls the output on the basis of the input and predefined program. A Programmable Logic Controller is a digital specialized computer used to control machines and processes. Programmable logic controller is used for operating a solenoid valve. It also operates flow sensor.

B. SCADA

SCADA (Supervisory Control and Data Acquisition) is a system used to monitor and control field instruments. It provides intelligence in the field equipment which allows us to communicate with SCADA unit. The hardware is configured by WinCC Simatic HMI and the status is displayed on the

SCADA screen. We are using Wonderware Intouch in our project.

C. Float Sensor

A flow sensor is a device for sensing the rate of fluid flow. Typically, a flow sensor is the sensing element used in a flow meter, or flow logger, to record the flow of fluids. A flow sensor is used in this system, in order to measure the amount of water that is entering into each tank.

D. Leakage Sensor

Leakage sensor is a device used to determine if leak has occurred in a system which contains the quantity of gas or liquid.

E. Pressure Sensor

A pressure sensor is a device for the measurement of pressure of gases or liquids. Pressure is the force required to stop a fluid

from expanding. It acts as a transducer and generates a signal.

F. Solenoid Valve

Solenoid valve is an electromechanically operated valve. It is connected to the output of PLC. It is used to control the flow of water that is entering into the house from the tank. The valve is operated by a PLC controller depending on the predefined program.

Advantages of Solenoid Valve

- More reliable.
- Long life.
- Safety switching.
- Fast switching.

G. Motor

Electric motor is a device which converts Electrical energy to Mechanical energy. We can give electrical energy to the system and extracts mechanical energy. Electric motors can be powered by direct current (DC) sources, like from batteries, motor vehicles, and by alternating current (AC) sources, like a power grid, inverters.

IV. Construction and Working

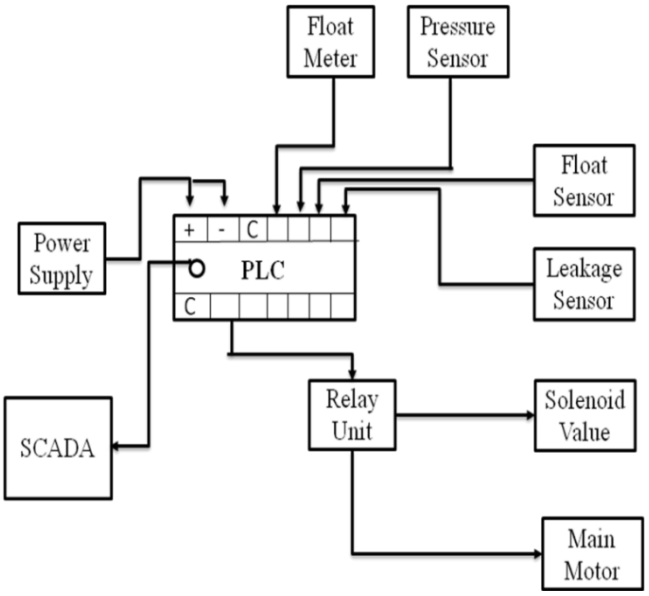

Fig1. Block Diagram

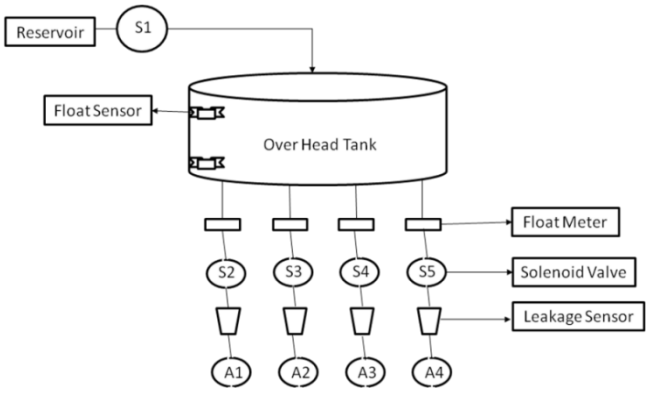

Fig 2. PLC based water distribution system

The above Fig2 show the implementation of the project. Consider the main storage tank is automated to fill from a reservoir with a solenoid valve in between. This tank is monitored with low- and high-level float sensors, so if the water in the tank is below the low level it is automatically detected and solenoid valve is opened to fill the tank. Similarly, once the water reaches the high-level float sensor the valve is automatically closed.

This operation is carried out in all the storage tanks that are connected to the system. Now from the main storage tank many sub-tanks are connected, each referring to main storage tank of each area. The sub-tanks are also monitored through flow sensors and depending on the water level the solenoid valve is opened or closed to fill the tank. These operations are controlled by the PLC, works based on pre-defined program or user requirement. In case of a leakage in the pipelines the leakage sensors indentifes the leak and the PLC controller automatically closes the solenoid valve of that particular tank. Hence each tank is fitted with a one solenoid valve to control the water flowing into the house, a flow sensor in order to monitor the water flowing into the tank and a leakage sensor to dectect any leak of water.

The SCADA software gives the complete visual representation of the work place in the control room. In case of any mishaps taking place, it can be viewed in the software.

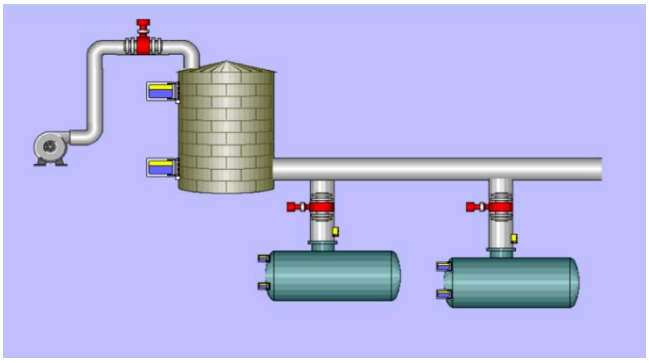

Fig 3. SCADA Representation

V. Ladder Diagram

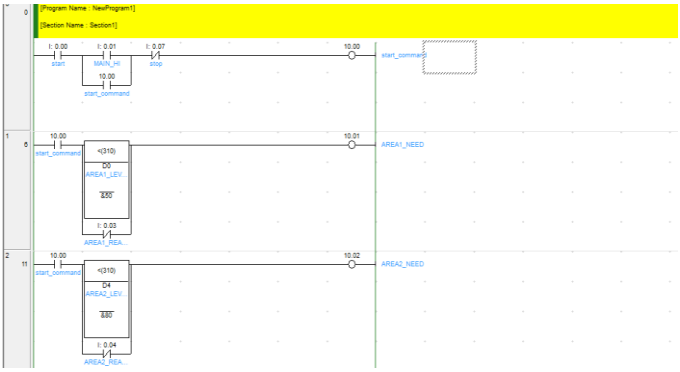

Fig 4. Ladder representation of the design

VI. Future Scope

A. The status of water usage and tariff can be checked and can be developed into an android application
B. Prepaid and postpaid methods are used for the charges of water usage
C. It includes the grey water treatment system for monitoring
D. Leakage detection in pipe can be implemented
E. By using SCADA we can able to monitor and control whole system from main control units
F. No man power is needed
G. Attaching water billing machine with the water supply makes easier for consumer to get their bills.

VII. Conclusion

In olden times the usual method is used which results in overflow, leakage, empty running. By using PLC and SCADA it becomes easy and possible for monitoring the water supply. It helps us to overcome from the problem of level, pressure, flow parameter. Hence, we successfully studied the program using ladder diagram.

References

[1] N.B. Bhawarkr, D.P. Pande, R.S. Sonone, P.A. Pandit, P.D. Patil, Literature Review for Automated Water Supply with Monitoring the Performance System, *International Journal of Current Engineering and Technology,* 4 (2014) 3328-3331.

[2] P. Mukesh Aravind, S. Sukhumar, C. Karthik, M. Jagadeeshraja, L. Manivannan N. Suthanthira Vanitha, PLC Basedautomatic Corporation Water Distribution System Using Solar Energy, *International Journal of Engineering Research & Technology (IJERT),* 2 (2013) 3100- 3105.

[3] A. Alinhussein, M. Adedalati, A Supervisitory Control and Data Acquistion (SCADA) for water pumping station of GAZA, The Islamic University Journal, 19 (2011) 303-321.

[4] R. Khare, F. R. E. Melo, Automation of Water Distribution Plant, *International Journal of Research in Engineering and Advanced Technology*, 2 (2014) 84-88.

[5] K. G. Shankar, Control of Boiler Operation Using PLC & SCADA, *International Jounal of Multi Conference of Engineering and computer Scientists*, 2 (2008) 19-21.

[6] G. S. Ashok, Water Anti-Theft and Quality Monitoring System by Using PLC AND SCADA, in *International Journal of Electrical and Electronics Engineering Research (IJEEER),* 3 (2013) 355-364.

[7] Prashant palkar, Shrinivas Patil, Pooja Belagali, Ashish Chougule, (2013) Automation in Drinking Water Supply Distributed System and Testing of Water, *IOSR Journal of Electronics & Communication Engineering (IOSRJECE),* 36-38.