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AUTOMATIC WATER DRAINING, FILLING AND DISTRIBUTION CONTROL SYSTEM USING PLC

[1]Peerasab Hawaldar, [2]A. V. Sutagundar
[1,2] Department of Electronics and Communication Engineering, Basaveshwar Engineering College,Bagalkot

Abstract-The present water supply systems are old and traditional systems in which there is more labor cost, wastage of water and these are un-reliable systems. Nowadays water is one of the most important resources, it must be utilize more efficiently. The PLC based water supply system will take over these issues. The proposed approach aim is to design and develop of such model to control automation that will meet the requirements of modern water supply system. PLC will be introduced to give a perfect automation. The main reasons of selecting this project is to have monitoring plus control the every stage of water supply system from a centralized location and also to minimize the number of labor cost required for troubleshooting and service by giving it automatic control. This is a pure industrial project and its scope is huge mainly in water supplying departments, water purification plants, and boilers and in every field where we have to supply water or any other liquid. PLC based water supplying system that monitors the water distribution among the different areas of a locality through a centralized remote location. So that this system would have minimum human dependency and maximum automation to save time, errors and off course money. The proposed model is simulated using INDRA WORK'S Engineering, which is firmware of REXOROTH BOSCH PLC.

Keywords-Water Draining, Filling And Distribution Control, Indralogic Ladder Diagram.

I. Introduction

The present scenario, many more areas are lacking in getting of sufficient drinking water, even though government has taken necessary steps to supply the water, some of the regions in India are not getting water supply even for other domestic usage also. Generally the water stored in overhead tank and distributed to nearby areas. In order to overcome normal conflicts facing during water supply and minimizing wastage of water in draining, filling and distribution of the different areas. Rapid growths in industrial automation and information technologies in recent decades, control of all equipment have been performed through the use of industrial computer. In most the application uses PLC's to connecting with computer for monitoring and controlling the various process. Some of the related works are as follows.PLC based elevator system with color sensing capabilities in industrial applications is proposed in [1], author explained the application to sort colored objects with color sensors and an industrial control of elevator for material handling in industrial plant with color capabilities. The ladder diagram for PLC based elevator control system incorporating color sensing features is implemented. This scheme is useful for industrial applications where box of different colors are to be downloaded at different floors. PLC based automatic corporation water distribution system using solar energy is proposed by author in [2], in this proposed work is automatic corporation water supply systems can be implemented by using PIC microcontroller and embedded controller preprogrammed to make an automatic control various operation of the system using PLC. Automation of waste segregation system using PLC is proposed in [3], author proposed work goal is support to Prime minister Modi's mission of Swacch Bharat Abhiyan can successfully implemented. This can be implemented at the municipal level or in some small scale industries to segregate waste more efficiently with reduction of manpower and cost. It improved more accurate and speed of waste management.

Automation in drinking water supply distributed system testing water using PLC is proposed in [4], author proposes the way to improve the water distribution system is by using industrial PLC and PC system, which includes all network components like flow sensor GSM modules, pH sensor etc. The water theft can be monitored by the flow variations given by the flow sensors mounted on the channels. The system includes Remote Terminal Units (RTU), flow transducers and actuators distributed on a wide geographical area, control and power panels for the pump stations etc. The reliable instrumentation connected to PLC or RTU assure real time monitoring of the main technological parameters of large water distribution networks. The data acquired of SCADA system (Supervisory Control and Data Acquisition) represent the support for optimization of the process and data- driven Decision Support System (DSS).

In [5], author describes the High stories in multi story buildings in most of the Middle East countries suffer from water shortage due to bad and old designs in water supply systems. An automatic regulation water supply system based on Programmable Logic Controller (PLC) and Variable Frequency Drive (VFD) is proposed. This paper explains water supply systems energy conservation principle of a pump with speed control according to disturbances. This system can supply water

[1]Corresponding Author

to the building with constant pressure and save energy efficiency. This system was tested for 24 hours a day for three weeks with capacity of (20 -120) L/min of water, and about 10 meters building height. The pressure of the supply network is about 1.2 Bar.

In [6], author explains the availability of drinking water is very huge problem in many states like a TamilNadu. Many people have been suffering a lot to bring water in time. The monitoring of water can prevent the occurrence of without permission and leakage of water effectively for the family circle. The proposed work which helps to make the system to be more efficient and pollution free, solar energy is used as alternative source for power supply for whole PLC system unit.

The problem formulation of this paper, currently water supply systems are old and traditional systems in which there is more labor cost, wastage of water and these are un-reliable systems. So in order to overcome the disadvantage of earlier systems, we are going monitor and distribution of water supply by centralized remote location being proposed. The objective of this paper is to design ladder diagram of such model to control automation that takes requirements, monitoring and control the every stage of water supply system from centralized remotelocation and to minimize the number of labor cost required.

The rest of the paper is organized as follows: Section II describes of the proposed system. Section III explains various components used. Section IV presents ladder diagram. Section V presents conclusion and future scope.

II. Proposed System

In this section, we describe the proposed system.Fig1.Shows the proposed block diagram based on which the interfacing various inputs and outputs is done with the PLC.

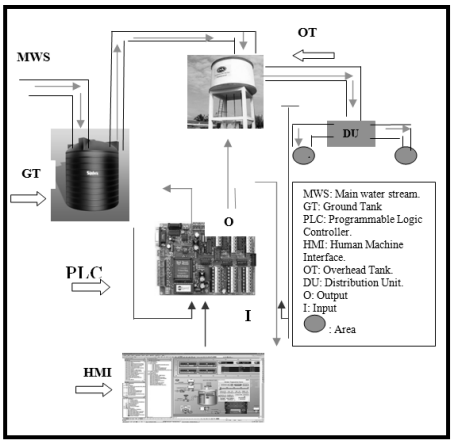

Fig1.Proposed system

According to above mentioned figure, demonstrates overall function of automatic water draining, filling and distribution control system. This system consists of three main modules, such as PLC, input and output respectively. In input system consists of Ground Tank (GT) and two infrared water level sensors to measure two levels (low and high), two 12V D.C water pumps is placed between GT and Overhead Tank (OT) and to pump the water to the OT. This GT stores the water and also supply to OT when needs. One is placed at bottom of the tank and other one placed topside of the tank to indicate low level and high level of water in the GT. Programmable Logic Controller (PLC) is the heart of whole system which process signals from the input sensors and performs the actions according to logic ladder diagram written for it. Output consists of OT and two infrared water level sensors to measure two levels (low and high), two 220V A.C Solenoid Valves to supply water to two different locations.

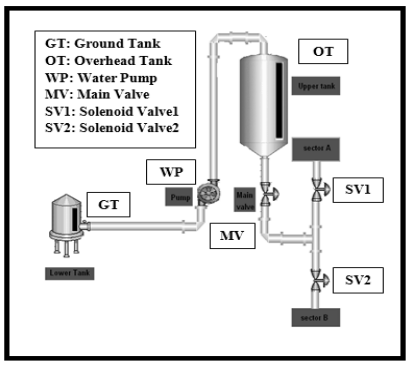

Fig2.Abraction View Proposed System

There are two Infrared sensors placed on the OT, upper end of the tank and lower end of the tank respectively If the water in the tank reaches lower end of the tank automatically water pump turn on and start to fill the tank. Similarly, if the water level reaches the upper end point automatically water pump turnoff in order to prevent the overflow of water. To obtain the proper distribution and utilization of OT water to two areas people, main valve is mainly used for the accurate measurement of the water distributing system and to indicate the outlet valve open or close process by providing two timer for each valve, based on prescribed time either one of the valve ON at any time. A Human Machine Interface (HMI) is the apparatus which presents process data to a human operator, and through this, the human operator monitors and controls the process.

III. Components Used

The main components used in the proposed system are discussed below:

A. Inputs

Input components are GT, Infrared water level sensors and water pump

a) Ground Tank (GT**)**: This ground tank stores the water and also supply to overhead tank when needs

b) Infrared Water Level Sensors: The infrared water level sensors are that uses infrared beam is used for level detection. TX-RX (Transmitter Receiver) IR LEDs are used for that purpose and a simple circuit with relays for digital output. It gives a digital signal when the beam path between transmitter and receiver is cut-off by water.

Fig. 3 Infrared water sensor

c) Water Pump**:** Water Pump is used to pump or supply the water from GT to the OT.

Fig.3 Water Pump

B. Programmable Logic Controller

Bosch Rexroth PLC is the important core unit in our project. It has control over all other elements which are connected to the PLC unit. The main function of PLC it acquire the signals from the input and perform certain actions according to logic ladder diagram written for it. Based on condition, output can be processed and controlled. In our project we are used Indralogic L10 series PLC with on board input and output modules.

Fig.4 Onboard input/output modules of PLC

C.Outputs

Output components are OT, Infrared water level and solenoid valve.

a) Overhead Tank (OT): This overhead tank it stores the water from which water can be distributed through a solenoid valve and also with two infrared water level sensor to measure two water levels (low and high) of the tank.

b) Solenoid Valve: A solenoid valves or electrical valves are electromechanical valve for use with liquid or gas. The valve is controlled by an electric current from PLC through a solenoid that the flow is switched ON or OFF. Solenoid valves consist of two main parts: The solenoid and the valve. The solenoid changes electrical energy into mechanical energy, then closes or opens the valve mechanically. We used three valves one main valves and other for sectors. By using PLC we can control whole city valves such valve is shown below.

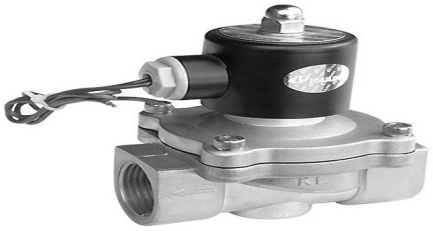

Fig. 5 Solenoid Valve

In Fig.1 shows, Output of the distribution unit consists of one main valve followed by two area solenoid valve and each valve is controlled by Main valve providing two types of timer for each valve they are On-Delay Timer takes an input, waits a specific amount of time, and then turns ON an output and allows logic to flow after the delay. Off-Delay Timer takes turns ON an output and keeps that output ON until the set amount of time has passed, and then turns it OFF the logic. Two additional components are used in our project is buzzer and beep sounds, so that user can easily understanding that either of the two tanks is high level or low level of GT or OT respectively.

IV. Ladder Diagram

A) Input and Output Configuration of PLC

Before monitoring the ladder logic diagram it is necessary to know about input and output configuration. Input from the system as based on Ladder Diagrams (LD). Table 1 and Table 2 gives details of various Inputs and outputs are used in proposed system

Table 1.List of inputs

Input	Type	Location
X0	Push button	Lower side of the GT

X1	Push button	Upper side of the GT
X2	Push button	Lower side of the OT
X3	Push button	Upper side of the OT
X4	Push button	ON/OFF switch

Table 2.List of Outputs

Output	Function
Y0	Sense low level of GT
Y1	Sense high level of GT
Y2	Sense low level of OT
Y3	Sense high level of OT
Y4	Water pump1(submarine motor)
Y5	Water pump2(To lift water from GT to OT)
Y6	Buzzer, indicates high level of either of the two tanks
Y7	Beep, indicates low level of either of the two tanks
Y8	Solenoid Valve 1, for area A
Y9	Solenoid Valve 2, for area B

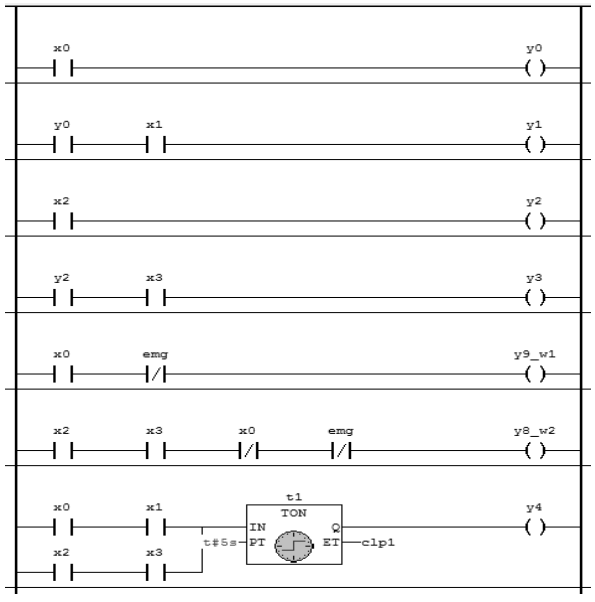

Fig:6a:Ladder Diagram Of Proposed System Given

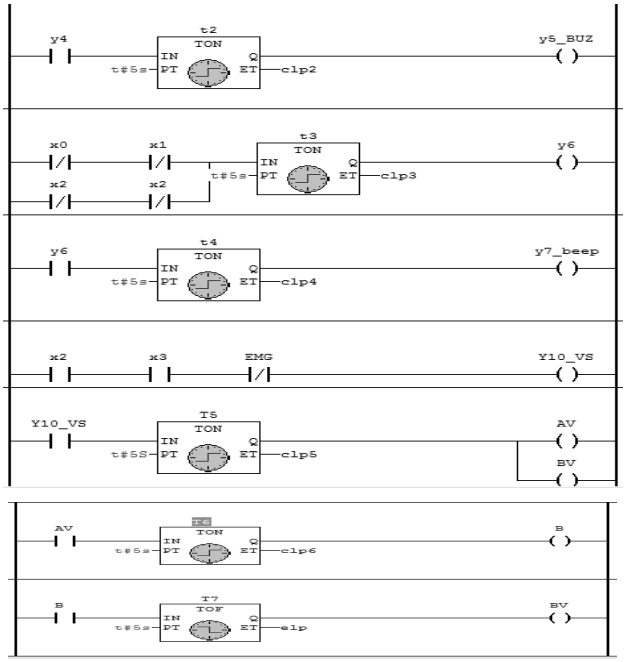

Fig.6b

V. Conclusion And Future Scope

The proposed method of automatic water draining, filling and distribution control system can reduce the water resources substantially and make the water management more effective and convenient to the public. Our research idea specifically designed for distributing the water equally according to the utility of the public needs and monitors the water distribution with minimum dependency of man power. This method is possible to solve the problems of traditional methods of water distribution system. We hope the proposed idea can make a great change in the old water distribution system and can give the benefit to the government by reducing the wastage of water, manpower and time consumption The results show the simulated and implemented system in the water distribution system with improved efficiency and increased accuracy of utility to the public.

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