

Automated Urban Drinking Water Supply Control and Theft Identification Using PLC and HMI

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Abstract - The main aim of studying this paper is to provide equal amount of water and prevent water theft. In countries like India there is labour called water man to distribute the water to required area. Since he is also a human being he may get laziness in his work, thereby water leakage or water over flow will cause water crisis. Hence this paper primarily focuses on water crisis, by making distribution of water efficiently by reducing wastage of water for urban areas. This is an intelligent system which ensures the balanced distribution of water throughout city/area with lesser human effort. The water theft can be best monitored by the flow variations given by the flow sensors mounted on the channels. This control system is further coupled with the HMI (Human Machine Interface). HMI is considered an interface that allows humans to interact with the machine. From an industrial perspective, the most valuable aspect of HMI technology is the ability to closely monitor production and respond to changing production demands, which improves efficiency.

1. INTRODUCTION

Next to air, the other important requirement for human life to exist is water. It is the Nature's free gift to the human race. India has 17 percent of the world's population and 15 percent of livestock, whereas it occupies 2.45 percent of the world's land mass with a scarce 4 percent of the world's water resources. Abjectly, India ranks 113rd (out of 180 nations) for its water availability, and 120th (out of 122 nations) for its water quality. As per the 2011 census, 31.16 percent of India's population lives in urban areas and nearly 17 percent of that in slums. The divide between the rich and poor is huge and over a quarter of the country's urban population lives in poverty. It is estimated that 80 percent of India's surface water is polluted. Apart from this, other challenges faced by India are increasing water consumption, wastage and water theft in urban areas. The long queues and hours of wait for free water tankers add on the prominent challenge of inadequate and unsafe supply of potable water. People then have no other option but to purchase water at greater costs yet of lower quality. The water resources are certainly inexhaustible gift of nature. But to ensure their services for all the time to come, it becomes necessary to maintain, conserve and use these resources very carefully. It is an established conservation and use of the water resources will definitely avoid the

chances of water famine for future generations for an indefinite period. Hence water supply systems are the crucial part of urban infrastructure therefore system must assure the continuity of the water distribution, water quality monitoring and control of technological parameter. Best policy to save water is to use it properly. As the world is progressing towards the future with an ever growing population and crave to the consumption of water, there would be a need to introduce uniform water distribution in order to avoid imbalance of water in various areas. The concept of water theft is valid-theft being the appropriation of water without the required payment, or in violation of existing rules. In order to overcome the above difficulties, uniform water distribution and theft identification system needs to be introduced, which ensures that everyone will get equal amount of water and it is also used to prevent water theft during the distribution period. For all agriculture and industrial areas there is excessive need of water therefore people suck the water from main street pipeline with the help of motor to their drain point. This

creates more water to flow from tank through pipeline to their drain point. So our idea is to make a fully automated system using PLC to improve the performance of water distribution system minimum human efforts and also ensures proper monitoring in case of water theft and illegal use of water. Thus this project proposes an implementation of adequate and resourceful use of water using a PROGRAMMABLE LOGIC CONTROLLER (PLC). The main objective behind this project is to improve the performance of the water distribution system with minimum human efforts.

2. Literature Survey:-

After reviewing various international research papers and reading previous project reports, it can be inferred that different methodologies can be used depending upon the location of distribution, availability of water and various other considerations. Most of the projects and papers incorporated PLC with SCADA or PLC with microcontroller. Hence we have incorporated PLC with HMI which will reduce wastage of water, detect water theft and help in providing uniform water distribution to everyone. Also monitoring and controlling of the system can be done efficiently.

A. Existing Technology: - In most of the cities, water is pumped from a large distance to a very high elevation and this process requires high amount of energy to move water from source to destination or the user. In PCMC area the water distribution infrastructure is widely spread effectively. In urban cities of developing countries often large quantity of water is supplied to only a few consumers, leading to inequitable water supply. Inequitable water supply to different users can be avoided by operating the system in an efficient manner. Nowadays water distribution system faces various problems like water leakage, inequitable water supply, water theft, drastic reduction in pressure of water, operator fault etc. We aren't able to identify the robbery in urban as well as in rural drinking water supply. Hence there is a need to develop a system to overcome these various problems.

B. Need for PLC: - PLC is an integral part of factory automation, industrial process control etc. It performs various functions simultaneously. All of the PLC's components and functions are centred around the controller which is programmed to perform a specific task. Here PLC is the integral part of automated drinking water supply system, which helps us in controlling the pumps, water level in the tanks, monitoring valves and measure the pressure of water. PLC is programmed by using ladder diagram language in RSLinx software.

C. Proposed System: - The conventional method used in older times where a person has to take the charge to go to the place and opening the valve. Once the time is over he will go again to that place to close the valve. Therefore this operation needs human interference and is also time consuming. The automation of the process thus helps to overcome these disadvantages. This whole automation process can be controlled and monitored on the screen of the HMI.

3. Methodology: -

The main of this project is to provide proper water supply to each consumer and to detect the leakage sites. In this

project we have worked on the distributed network under the area of single water tank. We have developed a system in which we can analyze the pressure from different branches of distributed network and compared it with the fixed bench mark. In this way we are able to control and monitor the whole system.

The disadvantage of existing system are overcome by automated water supply system such as-

The process of supplying water to particular area at particular time.

Water supply will automatically stop after reaching the fixed value limit.

The water theft and leakage are identified using pressure sensors. The PLC calculated the difference in the pressure rates of sensors, if the difference exceeds the limiting value it is recorded as leakage or theft, and the valve behind the first flow sensor/pressure sensor and distribution motor are turned off automatically.

Pressure Sensor:-

A pressure sensor is a device which is used for pressure measurement of gases or liquids. It is a device that senses pressure and converts it into analog electrical signal whose magnitude will depend on the applied pressure. As they convert pressure into an electrical signal they are also known as pressure transducers. In our system we have implemented flow sensor for theft detection in the system.

Level Sensor:-

A level sensor is a device which is used for determining the level or amount of fluid, liquid or substance. Here we have used the float type of level sensor. It provides the best reliability and flexibility for detecting water levels in storage tanks regardless of the applications.

HMI:-

In large industries it is next to impossible to control the individual parts of the system because, in most of the installations the parts are often located far from each other. Thus here the need arises to monitor and control the system with HMI (Human Interface Machine).

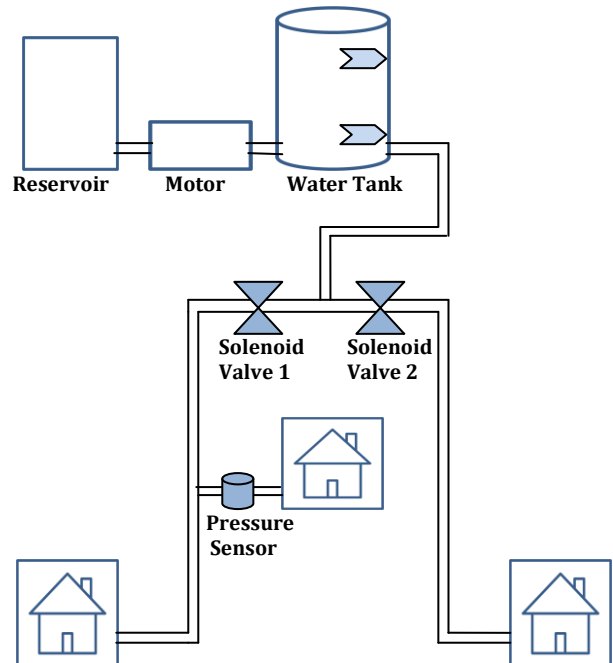
Pump:-

Pump is a mechanical device or an arrangement by which the water is caused to flow at an increased pressure and the process of pumping is known as pumping. A pump is used in this system, in order to move the water that is present in the main tank to the storage tank.

PLC:-

PLC is a solid state device that controls its output on the basis of its input and predefined program. A PLC is a specialized computer that is used to control machines and processes. It uses program memory to store instructions and execute specialized functions. There are a variety of PLC's that are available in the market, out of which we have used Allen Bradley according to our needs and applications.

6. Flow Diagram:-



4. Block Diagram:-

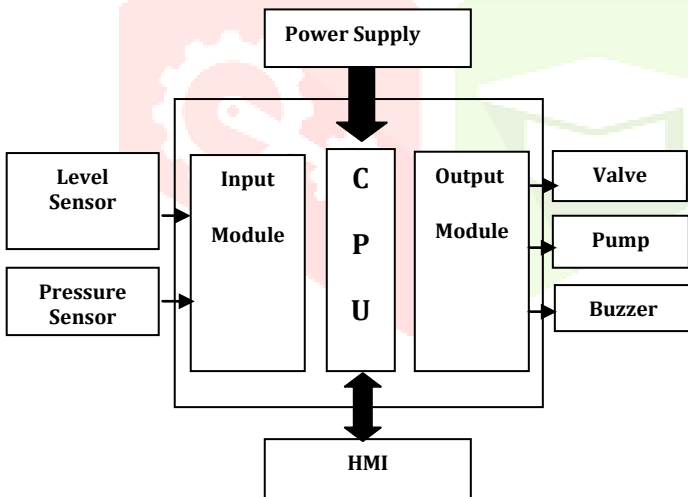


Fig. 1 Block diagram

5. Components:-

Solenoid valve:-A solenoid valve is used to automatically control the fluid flow. Solenoid valve is control unit which when energized or de-energized, either shuts off or allows fluid to pass through it. They have many uses including controlling water for irrigation, industrial uses for controlling process, residential uses such as ON/OFF taps in the homes. Here solenoid is connected to the output of the PLC and a two way solenoid valve is used.

7. Future Scope:-

1. GSM module can be used for status updates on mobile.
2. In future this system can be modified as; it will detect the exact location of pressure drop and this system.
3. It can be developed into an Android Application to check the status of the water usage and the applied tariff.

8. Conclusion:-

The automated water distribution system eliminates water wastage, provides continuous water flow from the source to destination, uninterrupted water distribution according to water level. It even reduces human efforts and also the errors caused due to human interference. The whole system can be monitored and controlled from the headquarters by using HMI. This automated distribution system can also help us to eradicate water theft.

9. References:-

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