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CENTRALIZED WATER MANAGEMENT VIA PLC AND SCADA

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ABSTRACT-

Water is an essential need for survival. Water is defined as "Beginning and the basis of all creation." In India most cities are water stressed, none of the cities are having 24/7 water supply. Therefore, it is a need to provide better water supply to every and to share the available water to every citizen as well as to prevent the unnecessary wastage of water. This proposed Centralized water management system via PLC and SCADA is used to distribute the domestic water evenly to all residential houses in the city and also depending on their needs to all the individual houses in the city. So that everyone will get the required amount of water depending on the number of members residing in each house and accordingly tariff will be applied. A set point is fixed for each house and the water from the storage tank to individual houses is measured with the help of flow sensors. Solenoid valve is used to open or close the valve automatically. If the flow rate of the water for a particular house for the particular time reaches its specified set point then a message will be sent to that customer and the tariff will be applied for the consumed extra water used henceforth. In this project we mainly concentrate on the distribution side. This system consists of PLC and SCADA. PLC helps to control the distribution of the water and SCADA is one of the emerging technologies which is used for complete monitoring and controlling. PLC gives the signal to the solenoid valve accord to the flow sensor output from the user. Our moto is to share the available water equally to all the consumers or citizen of the country. And so, it also creates awareness about conserving water.

Index Terms-PLC, SCADA, Flow Sensors, Level Sensors, Solenoid valves, RS485, Web Server.

I.INTRODUCTION

Now days, A paramount issue is water i.e., its availability, quality and management. Because there is a supersonic growth in wide urban residential areas, as a result there is a insufficient water Supply. Thus, there is a need to provide better water management system. To satisfy the customer's requirement as well as to avoid faulty conditions there must be a better water supply management. Water supply management can be defined as "Dealing with water in the best possible way". Problem arises in the water supply management system due to improper water supply management and they will have to pay an equal amount irrespective of usage of water by individual houses.

This paper hand down a prototype for water management system comprising a distribution, monitoring, and control system, through communication means, piping, actuators, sensors and valves. This system utilizes the communication bus for controlling and monitoring

waterflow through the piping and sensors via control of the actuators and valves. The reliable instrumentation connected to PLC (Programmable Logic Controller) pursue real time monitoring of the main technological parameters of large water distribution networks Control System and is coupled to Supervisory Control & Data Acquisition (SCADA) unit. This paper focuses particularly to a control system for controlling and monitoring components within a Water Distribution System. This system includes Man Machine & Electrical Interfaces to PLC for transmitting/receiving control and this is interfaced with the SCADA for monitoring and controlling and status data over communication bus. The details are then uploaded in the web server for the ease.

This proposed Centralized water management system via PLC and SCADA is used to distribute the domestic water evenly to all residential houses in the city and also depending on their needs to all the individual houses in the city. So that everyone will get the required amount of water depending on the number of members residing in each house and accordingly tariff will be applied. A set point is fixed for each house and the water from the storage tank to individual houses is measured with the help of flow sensors. Solenoid valve is used to open or close the valve automatically. If the flow rate of the water for a particular house for the particular time reaches its specified set point then a message will be sent to that customer and the tariff will be applied for the consumed extra water used henceforth. In this project we mainly concentrate on the distribution side. This system consists of PLC and SCADA. PLC helps to control the distribution of the water and SCADA is one of the emerging technologies which is used for complete monitoring and controlling. PLC gives the signal to the solenoid valve accord to the flow sensor output from the user. Our moto is to share the available water equally to all the consumers or citizen of the country. And so, it also creates awareness about conserving water.

II.BLOCK DIAGRAM

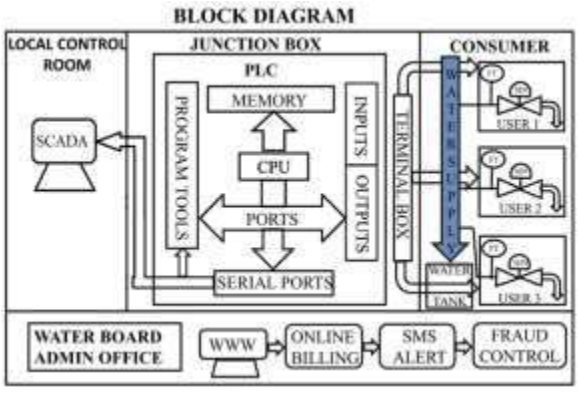


Fig No:1 Block Diagram

The above Fig No:1 shows the block diagram of this project Centralized water management system via PLC and SCADA. It comprises of following:

A. PLC controller
B. SCADA software
C. Flow element- Flow sensor turbine type

D. Water level sensor- Ultrasonic sensor.
E. Actuator- Solenoid valve
F. Pump
G. Communication buses. MOD bus, RS485
H. Web server

A. PLC (Programmable Logic Controller):

PLC is a solid-state device designed to control applications in the electro mechanical environment which controls its output corresponding to the basis of its input and predefined program. A Programmable Logic Controller is a specialized computer which is used to control the machines and its processes. It uses a programmable memory to store instructions and execute specific functions which include on/off control, timing, counting, sequencing, arithmetic, and data handling. Basically, the PLC is an assembly of solid- state digital logic elements designed to make logical decisions and provides outputs which is the input for the machine to be controlled. Initially the PLC was used to replace relay logic, but its ever-increasing range of functions made it to found in many and more complex applications.
Generally, a PLC have three components. They are

a. Processor: Brain of the PLC system.
b. Power supply: It converts the input source power into voltages required for internal circuitry.
c. Input/output: Inputs provide their status to PLC, validate voltage levels and outputs are used to drive the CPU decisions and put into operation.

In our Project, we are using Koyo Programming Software.

B. SCADA (Supervisory Control and Data Acquisition):

It is a system for remote monitoring and control system that uses computers, networked data communications and graphical user interfaces, programmable logic controllers. SCADA operates with coded signals over communication channels (using typically one communication channel per remote station). The control system can be combined with the data acquisition system by adding the coded signals over communication channels to acquire information about the status of the remote equipment (In our project, status of valves and sensors) for display or for recording functions. The term supervisory station indicates - servers and software which are responsible for communion with the field equipment (RTUs, PLCs, SENSORS etc.), and then to the HMI software that is running on workstations in the control room or elsewhere. In our Project, we are using Point of View.

C. Flow Sensors:

A flow sensor is a device which senses the rate of fluid flow. Typically, a flow sensor is the sensing element used in a flow meter, or flow logger used 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 house.

Here we use, Turbine type-flow meter. The flowing water engages the vaned rotor makes it to rotate at an angular velocity of the rotor results in the generation of an electrical signal or pulse. The summation of the pulsing electrical signal is directly related to the flow rate.

Water Level Sensor:

Liquid level sensors are being used to detect the liquid levels. Here we used to measure the level of water. They can be defined as sensors or transducers. A water level sensor is used in this system, in order to indicate the amount of water that is present in the municipal tank. Ultrasonic level sensor is been used.

Ultrasonic level sensors work by the "time of light" principle using the speed of sound. It is placed on the top of the tank. The sensor emits a high frequency pulse, usually in the 20kHz to 200kHz range, and then listens to the echo which is reflected back to the transmitter from the liquid surface. The transmitter measures the time delay between the transmitted and received echo signal. The distance is calculated by the microprocessor by using the formula.

Distance= (Speed of sound in air * time delay) / 2

D. Solenoid Valve:

A solenoid valve is an electromechanically operated valve that are frequently used in fluidics. The valve is controlled by an electric current through a solenoid: in the case of two- port valve, the flow is switched on or off; in the case of a three-port valve, the outflow is switched between two outlet ports. A solenoid valve is used in this system, in order to control the flow of water that is entering into the house from municipal tank. The solenoid valve is operated by the PLC controller corresponding to the predefined program.

Here we use plunger-type actuator- Normally closed. This valve has a solenoid and the valve. The solenoid converts the electrical energy into mechanical energy, which in turn opens or closes the valve mechanically. A spring used to hold the valve closed when solenoid is not energized.

E. Pump:

A pump is a device that moves fluids or liquids, gases, or sometimes slurries, by the mechanical action. Pumps are differentiated by their mechanism to used to move the fluid: direct lift, gravity pumps and displacement pumps. Pumps operate by some mechanism to consume energy which is used to perform mechanical work to move the fluid. Pumps can operate via many energy sources, including electricity, manual operation, engines or wind power, come in many sizes. The pump is used in this system, in order to suck the water that is present in the sump to the municipal tank.

F. RS485:

RS485 is a versatile communication standard defining the electrical characteristics of drivers and receivers which are

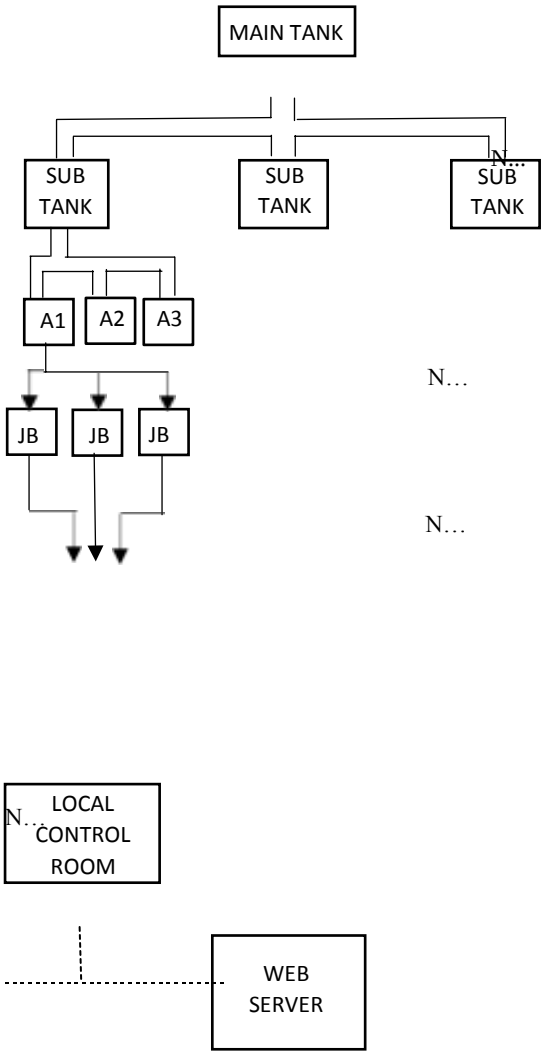
used for the serial communications. It is a multidrop bus. It is supported by balancing electrical signaling and multipoint systems. It has the ability to communicate over longer distances up to 1200metre and at a faster communication bit rate of 35mbps. Here we use RS485 CC cable CAT5 Breaded cable.

G. Web Server:

A web server is a program, uses HTTP which is known as Hypertext Transfer Protocol. It helps to serve the files that form web pages to users, according to the user requests i.e., sent through computers or mobile phones by the HTTP clients. Appliances dedicated for this purpose are known as web servers. Here we use to update the status of the SCADA to the webserver for the user reference and communication purpose.depending on the predefined program and User requirement. The needs of the user can be communicated through web server or telecommunication. The

SCADA software gives the complete pictorial representation of the Field to the work place or the control room. So, every operation happening in the field can be visually viewed in a SCADA from a control room itself. The complete database will be uploaded in the web server for the user reference. WIRING DIAGRAM

III.DESIGN LAYOUT



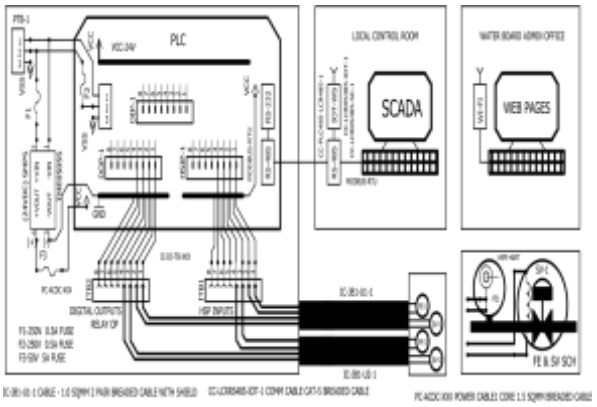


Fig No:3 Circuit Diagram

Fig No:2 Field Diagram

The above Fig No:2 shows the Field Diagram of the project Centralized water management system via PLC and SCADA. It explains the implementation of the project in the real world.

A flow meter and a valve are fitted in each consumer side. So that, the water entering into the houses are measured via Flow sensors which is used to trace or monitor the amount of water that is consumed. The PLC controller takes the status of the Flow sensor and performs the predefined ladder logic program and PLC sends the corresponding signal to the solenoid valve of the particular house in order to stop the water flow or to allow the water flow into the houses

IV. IMPLEMENTATION

A. Security System:

In this system we are implementing a centralized monitoring and controlling of water and also an informatory system. Monitoring of water and distribution of water based on tariff can reduce the wastage of water because a threshold limit is given to the user and it is monitored.

B. Allocation System:

In this system we are setting a limit for per month usage depending on the number of members in each house. Even then if they need more water using web server or telecommunication user can request for more water if needed. So, each family or each house will be aware of their consumption.

C. Billing and Report generation:

In this section each house will be having a virtual record on their consumption of water with the help of SCADA (Supervisory Control and Data Acquisition). According to the record maintained a report and bill will be generated for each house automatically.

D. Information System:

In this section we are implementing SMS alert through which each customer will be reminded by the monthly limit warning.

IV.BACKGROUND THEORY

Many systems had proposed to solve the water management problems but they have their own disadvantages. We have considered the following papers as reference to our project idea:

1. Automated water distribution system Using PLC and SCADA (2015)
2. PLC Controlled Water Distribution System (2015)
3. Automated Urban Water Supply System and Theft Identification (2015)
4. Theft Identification and Automated Water Supply System Using Embedded Technology (2013)
5. Theft Identification and Automated Water Supply System Using Embedded Technology (2014)
6. Automated Water Supply System and Water Theft Identification Using PLC and SCADA (2014)
7. Water Anti-Theft and Quality Monitoring System by Using AVR and SCADA (2014)
8. Water anti-theft and quality monitoring system by using PLC and SCADA (2013)
9. Conceptual Design and Development of Water Metering System for Multiple Family Residential Buildings (2012)
10. Automated urban drinking water supply control and water theft identification system (2011)

Hence there is a need to develop an efficient water supply management and billing system, so we have come up with the idea of Centralized Water Management via PLC and SCADA is used to distribute the domestic water depending on their needs to all the individual houses in a city so that everyone will get the required amount of water depending on the number of members residing in each house and accordingly tariff will be applied. If the amount of water allocated for a house exceeds

the limit, then a warning message will be sent to that particular house and the tariff applied will be hiked for the extra water used henceforth. Since we had applied tariff for the extra usage of water, wastage of water can be avoided and the awareness of the water scarcity can be created. PLC controller, it is an efficient controller to solve water management problems in small as well as very large area.

V.APPLICATIONS

- Maintains the record of the usage of water.
- Automatic bill generation.
- Avoid wastage of water.
- Theft identification.
- Easy maintenance.

VI.FUTURE SCOPE

- It can be developed into an Android Application to check the status of the water usage and the applied tariff and even the bill payment for water usage can be made either Pre-paid or Postpaid.
- The Grey water treatment system monitoring can also be enhanced with this.
- The fault or leakage detection system in the pipes can be implemented.

Water PH monitoring system can also be enhanced with this.

VII.CONCLUSION

The automation of water distribution system eliminates water wastage. Automation of monitoring system eliminates water theft. Automation of controlling system enhances supplying of water equally to all consumers. Hence, Automation system provides continuous water flow according to the set point to all. As this project is automatic, it may reduce lots of man power. On the other hand, automation also requires continues human supervision. The water wastages such as leakages, mankind laziness and operating error can be avoided by this. The automation implemented in water management system ensures to provide a best and efficient water supply distribution system and also the customers will pay only for the used amount of water. Implementation of tariff would create an awareness not to waste the water.

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