

Leak and Theft Identification with Contamination Detection in Urban Water Supply System using Embedded Technology

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Abstract—With the continuous economic growth, the water demand is also increasing. The monitoring of water resource for these enterprises can prevent the occurrence of stealing water and leaking water effectively. Urban water supply networks form the link between drinking water supply and drinking water consumers. In this modern society if the water supply system is an automated process means it will be a huge benefit for the citizens. It is time saving one, reduce human power and last but not least it will save water for our future generation. In this proposed concept water flow is measured by using water flow sensor and the suction or leakage is detected by setting the threshold level. Leakage or suction node is identified by message alert.

Index Terms—PIC, Water Flow Sensor, GSM, Solenoid Valve

I. INTRODUCTION

At the present with the regular economic growth, the need of water for both commercial and non-commercial purposes is also rising. The water supply process is a part of the urban and rural areas which should ensure the stability of the water distribution, the water quality control and the monitoring and control of the other technological process criteria's, and deals with the limitations enforced by the water availability, hydrological conditions, the storage capacity of the tanks and water towers and the increasing rate of usage of water [1]. The supervising of water resource supply system can find the occurrence of stealing water and leaking water efficiently. Water supply system networks form the link between main water tank (resource) and drinking water consumers. This large network is playing a vital role for the survival of human life, for economic development, and for the continuous operation of industries and hospitals. In this world, water supply system is a public enterprise, generally part of a local government, but nowadays private industries also interested to do the same thing. In this proposed which is aimed to develop an embedded based wireless water supervising and theft identification system by monitoring and controlling the flow rate of water at the user end. In this system GSM technology is used for communication and water flow sensor is used to measure the flow rate. In

addition contamination detection is also employed by measuring the pH level of water.

A. Water Supply System

Urban water supply networks form the link between drinking water supply and drinking water consumers. Water supply networks consist of transmission lines, distribution lines, and service lines.

- Transmission lines convey large amounts of water over large distances.
- Distribution lines afford intermediate steps toward delivering water to the end customers.
- Service lines deliver the water from the distribution mains to the end customers.

The water supply systems are part of the urban infrastructure which must assure the continuity of the water distribution, the water quality and the monitoring and control of the technological process parameters, and deal with the restrictions imposed by the water availability, the storage capacity of the tanks and water towers and the increasing diversity of water use.

B. Leakage

The efficient distribution of water is a subject of major concern for water utilities and authorities. While some leaks in water distribution networks (WDNs) are unavoidable, one of the main challenges in improving the efficiency of drinking water networks is to minimize leaks.

Leaks can cause significant economic losses in fluid transportation and extra costs for the final consumer due to the waste of energy and chemicals in water treatment plants. Leaks may also damage infrastructure and cause third-party damage and health risks.

C. Suction (Water Theft)

Some people use $\frac{1}{2}$ HP to 1 HP pump to suck the water directly from the channel of their home street. Due to their activities some people will be suffered with lack of water. To avoid this problem several supervision processes have been undertaken by the government with direct

intervention. But it is not possible in all time due to lack of human resource.

II. EXISTING SYSTEM

In existing system, urban water distribution to the users is with the help of some man power. The person will go to the place and then open the valve to that particular area. Once the time is completed the person will go again to that place and close the valve. This type of operation needs man power also waste of time to go to that place and come back often. Also the people may take excess water for their personal use with the help of motor or some other devices. Due to this many users will not receive sufficient water for their use.

Water is the basic needs of the human life. So it should be given to the people properly and at right time. The theft and leakage can be prevented only when any public inform the officials about the theft. But the probability of public is informing to higher officers are rare. So the theft prevention or one who does the theft is difficult to identify in the early methods.

III. PROPOSED SYSTEM

In this research work, it is proposed that the usage of Anti-theft control system for drinking water supply. By implementing this proposed system in a real time; surely it will be able to control the drinking water theft in the urban areas. In urban areas the water supply to residence and commercial establishments are provided at a fixed flow rate. There are incidents of excess water drawing by certain customers/users by connecting motor-pump sets to the water lines which is considered as water theft.

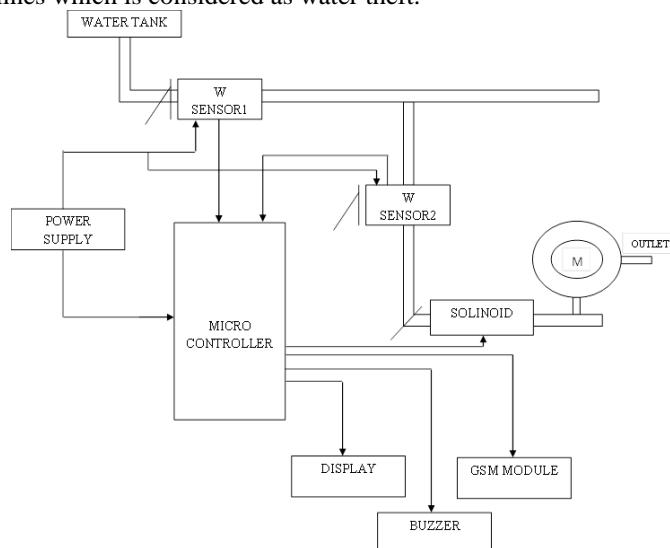


Fig 1 Block diagram of proposed system

In this work, it is proposed to develop an embedded based water leakage detection and theft prevention system by recording the flow rates of water at the provider /user end. In order to implement the proposed water supply system, each consumer end should be afford with water flow sensor and the provider location consists of microcontroller to record the flow rate using a flow sensor and GSM modem which is used to transmit the message

Identification of leakage is not performed by an automatic controller. This project circumvents this issue by employing a PIC microcontroller to automate the process. Leakage and suction of water are identified by the pattern of water flow rate which is monitored continuously by the processor and if the same goes beyond a predefined threshold level, suitable alarms or annunciators are triggered to notify the leakage or theft. This information is passed to any number of mobile phones, whose numbers are stored in the PIC microcontroller itself.

IV. SYSTEM DESCRIPTION

The flow rate is sensed by the signal conditioning unit when the water is passed through the pipeline. The sensor operates under certain pretend value. When there is a in the water flow due to leakage or any pumping of water through motor, it will be detected by the water flow sensor. The signal conditioning unit is used to give the desired input signal of the ADC.

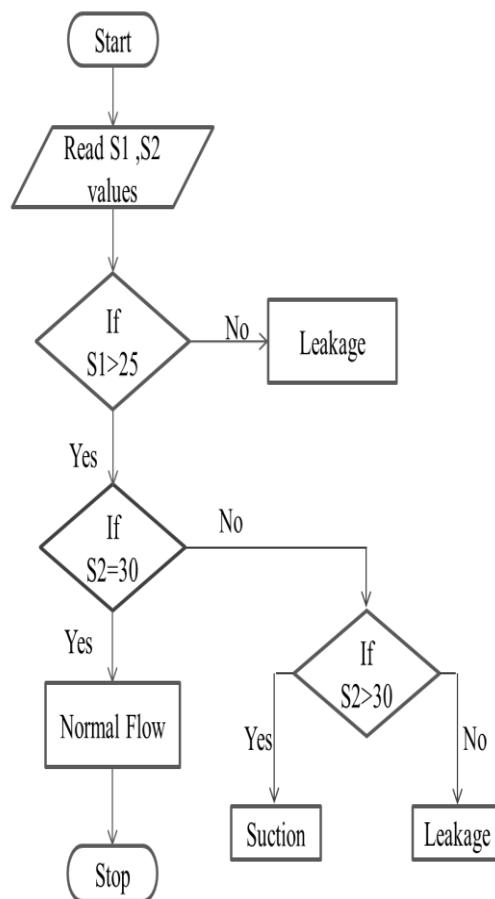


Fig 2 Flow diagram of proposed design

The analog signals generated due to variation in the flow of water sensed by the water flow sensor are converted into digital signals using Analog to Digital Convertor (ADC) and this digital signal is given to Microcontroller. This microcontroller enables the transmitter signal for intimate to water supply board. At the same time they enable the driver unit to closes the solenoid valve

The system is provided with an electrically operated solenoid valve to supply water to the consumers. The system is provided with an electrically operated solenoid valve to stop the water supply whenever the flow rate exceeds a Predefined limit. The microcontroller will switch ON/OFF the solenoid valve using a relay switch. It is proposed to employ a GSM MODEM for wireless communication so that the information can be passed to many responsible officers cell phone for immediate action.

The communication is done with help of MAX232 IC between the microcontroller and GSM. To communicate over UART or USART, we just need three basic signals which are namely, rxd (receive), txd (transmit), gnd (common ground). So it is interface MAX232 with any microcontroller.

A. PIC16F877A

In this proposed design PIC16F877A act as CPU of the hardware unit. It can be programmed to bring out an enormous amount of tasks. The features of PIC16F877A is given below:

- High performance RISC CPU
- Interrupt capability (up to 14 sources).
- Power on Reset (POR).
- Low power- high speed CMOS flash/EEPROM
- Wide operating voltage range (2.0 – 5.56)volts.
- High sink/source current (25mA).
- Up to 8K x 14 words of Flash Program Memory,
- Up to 368 x 8 bytes of Data Memory (RAM)
- Up to 256 x 8 bytes of EEPROM data memory

B. Water Flow Sensor

Water flow sensor consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow. The hall-effect sensor outputs the corresponding pulse Signal.

- Working Flow Rate: 1 to 30 Liters/Minute
- Working Temperature range: -25 to 80°C
- Working Humidity Range: 35%-80% RH
- Maximum water pressure: 2.0 MPa
- Output duty cycle: 50% +-10%
- Output rise time: 0.04us
- Output fall time: 0.18us
- Liquid temperature <120 °C

C. GSM

The GSM (Global System for Mobile) is SIM900 Quad-band GSM / GPRS device, works on frequencies 850 MHZ/ 900 MHZ/ 1800 MHZ and 1900 MHZ. It is compatibility in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5V DC TTL interfacing circuitry, which allows User to directly interface with 5V Microcontrollers (PIC).

It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The modem can be interfaced with a Microcontroller using USART (Universal Synchronous Asynchronous Receiver and Transmitter) feature (serial communication).

D. Solenoid Valve

The system is provided with an electrically operated solenoid valve to supply water to the consumers. The valve turns on/off by the central processing station PC to supply the water for a particular time period. The system is provided with an electrically operated solenoid valve to stop the water supply whenever the flow rate exceeds a Predefined limit. The microcontroller will switch ON/OFF the solenoid valve using a TRAIC switch. It is proposed to employ a GSM MODEM for wireless communication so that the information can be passed to many responsible officers cell phone for immediate action.

V. RESULTS AND DISCUSSION

The Fig. 4 shows the microcontroller section of the proposed system. It has a PIC microcontroller, water flow sensor and a GSM modem. In a case if a leakage is occurred then the controller will send a signal to the buzzer stop the flow of water to that particular node. Then a message will sent using the GSM to the officer mobile indicating about the leakage and where the leakage occurs. In case if theft is occurred then the controller will send a signal to the relay circuit to close the solenoid valve nearby that node. Then a message will sent using the GSM to the officer mobile indicating about the theft and where the theft occurs.

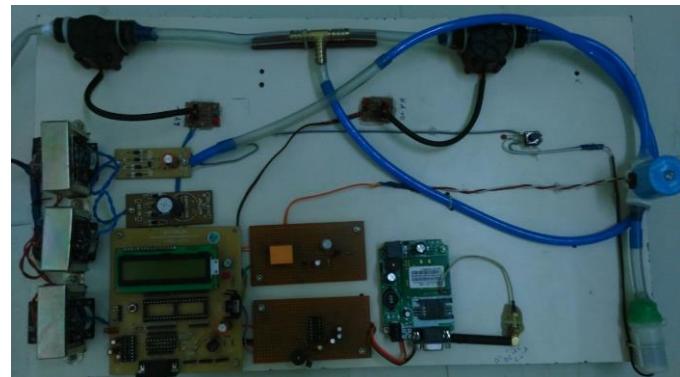


Fig 2 Microcontroller Unit

VI. CONCLUSION

The Urban area water supply system can be effectively replaced by the surveillance and fully automated system proposed in this project. The automated system implemented into the water distribution network insures the update of the refurbished water supply urban utilities. It offers new ways of monitoring and optimized exploitation of the water resources and technological equipments. The monitoring of urban water supply system is based on PIC microcontroller. This automated system not only used to monitor the water supply it is also used to find and avoid the leakage and theft of water.

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