# Smart Water Distribution and Management System

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***Abstract -*** *Water is one of the most important resources for all living beings in the earth. In a country like India with huge population, distribution and management of water is found to be uneven. The ever increasing demand for water emphasizes activities related to water management, ensuring the rational development and utilization of water resources. It also requires the development of necessary devices and networks to optimize the usage of water and ensure safe drinking water. An attempt is made in this research work to rationalize water supply to consumers; understanding losses, taking corrective decisions and also to build a clear, accountable and efficient water supply system. A simple set-up is established with four users, one main distribution tank and arudino controller for demonstration of the management system.*

***Keywords — leakage, level, raindrop, smart, solenoid (****key words****)***

## I. INTRODUCTION

Water saving is the one of the main objectives behind all the development and control. Water scarcity happens to be one of the current issues in the world. Earth is full of water. However, 97% of available water is in sea which is salty and hence cannot be used as it is. 2% of water is in glacier which is in ice form. Hence, only 1% of water is available as groundwater and surface water for human survival. According to a professional survey conducted recently, it is observed that almost 1.3 billion litres of water per day is needed in India. However, only 900 million litres of water are supplied to the citizen. Old and poorly constructed pipelines, inadequate corrosion protection, unauthorized water connections and poor maintenance are some of the factors contributing to wastage such as leakage and over flow. If it is possible to save this wastage of water, then required quantity of water can be supplied.

In a city or colony or town, water is being sent to a main distribution system and process of water distribution to the users takes place from the system. In the existing system [1]-[2], distribution of water is based on the bill payment but not on the need of the consumers and history of pattern of consumption of the consumers. Further, advanced technology [3] is not being employed to sense water leakage, overflow and water levels in a public distribution system. [4-6] deals with a survey on the technology used in sensor based water quality monitoring system and but does not describe the effective water distribution management system. Role of IoT [7] in smart cities is investigated to determine the focal points and essential elements for the successful developments of a smart city. IoT based [8] water quality monitoring system is presented. This system also takes care of the measurement of few physical parameters [9]. Real time flow and pressure measurement [10] are used for state estimation in a water distribution network. A system which can measure the water level and send the measurement data by SMS is proposed in [11]. An attempt is being made in this article to use appropriate sensors for detecting the leakage, overflow and low water levels. The sensed and measured data are being collected and stored in a control centre. Based on the data and need of consumers over a period of time, distribution of water is scheduled for different areas in the distribution system. Wastage of water is sensed and avoided with appropriate remedial measures.

## II. OBJECTIVES OF THE PROPOSED WORK

The primary objective of this research work is to supply water to the consumers based on the requirement and manage water distribution in an efficient manner. The proposed system detects the leakage in the water distribution system at the earliest. It makes use of water flow sensors to detect the leakage. This information obtained is recorded in the database enabling the authorized user to access the information easily. This information can be used at the time of report generation. A solenoid valve is provided in the system in order to cut down the water supply by closing the valve in case of heavy leakage, thereby saving the water. Hence, maintenance of the water distribution system is made easy for the authority.

The main objectives of the project are listed as:

- To implement this system in smart cities for managing and distributing water in an effective way.
- To detect leakage in water distribution system at the earliest by using the raindrop sensors.

- To notify the authorized persons about the leakage in the system.
- To provide easy maintenance of the water distribution system for the authority.

## III. SMART WATER DISTRIBUTION SYSTEM

Block diagram of the proposed smart water distribution and management system is shown in Fig. 1. The Arduino Mega 2560 microcontroller is the main platform which is used in order to accomplish all the desired control actions since it has more memory space and I/O pins compared to other boards available in the market. The electronic circuitry necessary to implement the project is connected to the Arduino, which senses the signals from the sensors and activates control signals to the valves, IoT platform and motor in order to achieve the desired control actions.

Water is distributed to the end users based on the availability of water in the MDT (Main Distribution Tank). To accomplish this, MDT is divided into three different regions:

- When the tank is full, it is considered as 100%.
- When the tank is half-full, it is considered as 50% and
- When the water level in the tank reaches 25%, it is considered as threshold value.

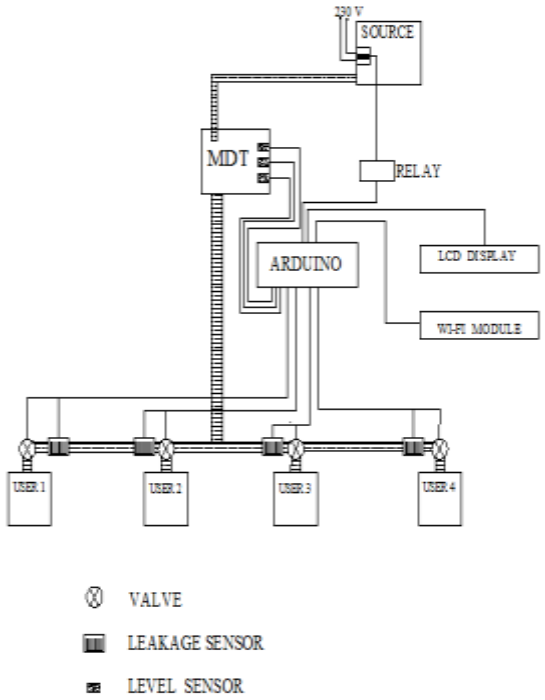


Fig. 1. Block diagram of the proposed system

Three water level sensors used to sense the three different water levels in the MDT are placed in three different heights of the tank to measure the water level in the tank. They are connected to the analog pins of the Arduino board. As soon as a water droplet falls on a leakage sensor (which is raindrop sensor), the track of the brick inside the sensor gets shorted. Larger the amount of liquid falling on the sensor, more the output voltage will be. This signal is used by the Arduino to energize a solenoid valve. The valve is such that when energized, the plunger opens and allows the water flow through the cavity port.

When the output of water level sensor 1 is high, the tank is 100% full and all four valves are opened and water is distributed to all the four end users shown in Fig. 1. When the output of water level sensor 2 is high, the tank is 50% full and the first two valves are opened. Water is distributed to end users 1 & 2. When the output of water level sensor 3 is high, the tank is 25% (water is at low level /Threshold level in the main distribution tank) full and all four valves are closed. Then, there is no water supply to any of the end users. If the tank is 25% full, the water is pumped to the main distribution tank from the source by using a submersible pump which gets activated after the relay is switched on. The main purpose of using this submersible pump is that it prevents pump cavitation.

The leakage during the water supply from the main distribution tank to the end users is rectified by using the rain drop sensor. The rain drop sensor is placed near each of the end user tanks. When there is a water drop on the sensor, the resistance reduces because water conducts electricity and presence of water connects Nickel lines. Therefore, the resistance is reduced and hence there is a voltage drop across it. The analog voltage output and digital switching output are sensed by the Arduino board. Due to this action, the solenoid valve near the respective sensor is energized to close the orifice to stop the water flow. This information is then updated in the Thingspeak IoT platform through Wi-Fi module. ESP8266 WI-Fi module is used. It sends the live data regarding the water leakage to the Thingspeak IOT platform in which all the data is stored and can be accessed at any time from any location by the authority.

The leakage of water flow is specifically communicated to the authority as follows.

- When there is any leakage detected in the system, the data is sent to Thingspeak application by using Wi-Fi module ESP8266. The data is stored in the application.
- It stores the data and displays the exact time and exact location of leakage occurrence.
- This data can also be used for future reference by the authority.

The entire setup of the smart water distribution is implemented in the hardware which is shown in Fig. 2.

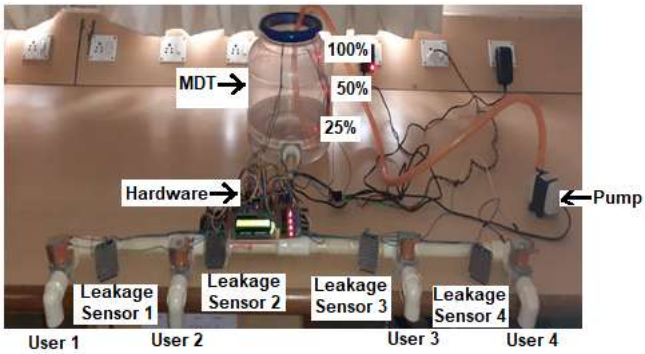


Fig. 2. Hardware setup

## IV. TESTING METHODS

The following cases describe the various testing methods used to analyze the proposed system under different operating conditions.

The testing methodologies used in five different cases are shown in Fig. 3, Fig. 4, Fig. 5, Fig. 6 and Fig. 7 respectively. Table 1 gives control actions taking place in the five different cases.

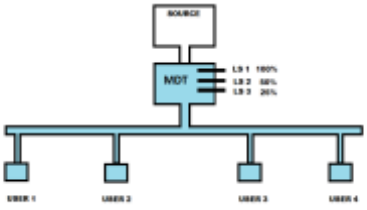

Fig. 3. Testing - Case 1

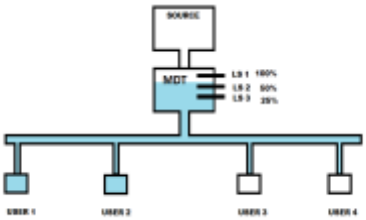

Fig. 4. Testing - Case 2

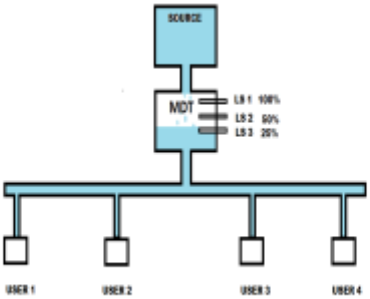

Fig. 5. Testing - Case 3

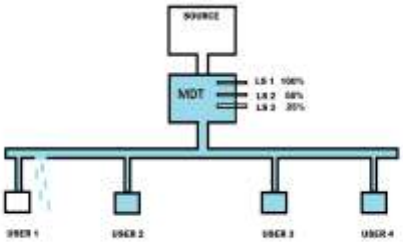

Fig. 6. Testing - Case 4

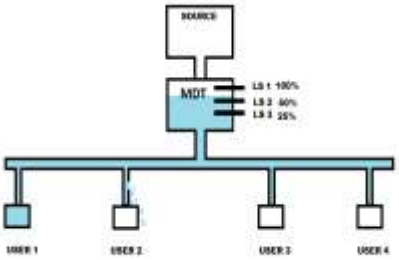

Fig. 7. Testing - Case 5

**TABLE I. TESTING METHODS WITH CONTROL ACTIONS**

| ***Case/ Control actions*** | ***Case 1 (Water level is 100% )*** | ***Case 2 (Water level is above 50% and below 100% )*** | ***Case 3 (Water level drops below 25%)*** | ***Case 4 (Leakage in valve 1 and the water level is 100%*** | ***Case 5 (Leakage in valve 2 and the water level is below 50%)*** |
|---|---|---|---|---|---|
| **Submersible motor/ Leakage Sensor** | The submersible motor in the water source (tank) will be in off condition. | The submersible motor in the source will be in off condition. | The submersible motor in the source tank gets turned on and it will pump the | Leakage sensor near it will sense the leakage and water flow through valve 1 stops automatically | Leakage sensor near user 2 will sense the leakage and water flowing through valve 2 stops automatically. |

| *Case/ Control actions* | *Case 1 (Water level is 100% )* | *Case 2 (Water level is above 50% and below 100% )* | *Case 3 (Water level drops below 25%)* | *Case 4 (Leakage in valve 1 and the water level is 100%* | *Case 5 (Leakage in valve 2 and the water level is below 50%)* |
|---|---|---|---|---|---|
| | | | water from source to the MDT till the water level reaches 100 %. | y. | |
| **Solenoid Valves** | All the valves will be opened. | Valve 1 and valve 2 will be opened. Valve 3 and valve 4 will be closed. | All the valves will be closed. | Other three valves will be opened. | Valve 1 will be opened. Other three valves will be closed. |
| **Water flow** | Water flows through all the valves. | Water flows only through valves 1 and 2. | Water flow doesn't take place through any of the valves. | Water flows through valve 2, valve 3 and valve 4. | Water flows only through valve 1. |

As an illustration, water leakage happening near end user 4 is communicated through this platform as shown in Fig. 8. It is evident from Fig.8 that the information of the leakage with respect to the location and time are displayed.

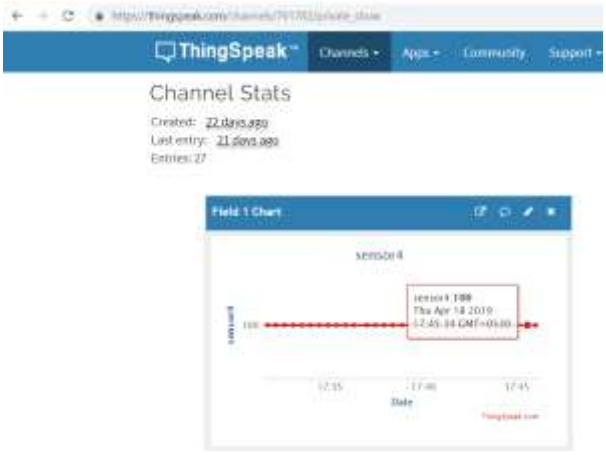


Fig. 8. Display on the IoT platform

## V. CONCLUSIONS

In this research work, a major module in Leakage Detection in Water Distribution System is successfully implemented; water leaks are detected in different parts of the system by processing the signal from the sensor and hence notifying the leakage in different parts of the system to the authority through Things Speak IoT platform to respond to the leakage at the earliest. Exact location and time of occurrence of the leakage are made available. Water distribution based on the levels in the MDT and requirement of users is fully automatic.

An attempt has been made for smart water distribution on a prototype basis with only few end users, sensors and valves. The same idea can be extended to many distribution tanks and consumers. The proposed system of smart water distribution and management system can be used in smart cities. The data collected from IoT platform can be used for further analysis like consumption forecasting, etc. This system can be implemented by using level sensors which would render an accurate water level and it can be operated by using Smart Phones.

## REFERENCES

[1] M.V. Pavankumar, A.B. Kumbhar, P.H. Prasad, S.B. Prashant and P.V. Akshay, "*Automated Town Water Management System*," International Journal of Research in Advent Technology, vol. 2, no. 4, pp. 132-134, April 2014.

[2] E. Vinothini and N. Suganya, "*Automated Water Distribution and Performance Monitoring System*," International Journal of Engineering and Innovative Technology, vol. 3, no. 8, pp. 30-32, February 2014.

[3] N.B. Bhawarkar, D.P. Pande, R.S. Sonone, M. Aaquib, P.A. Pandit and P.D. Patil, "*Literature Review for Automated Water Supply with monitoring the performance System*," International

Journal of Current Engineering and Technology, vol. 4, no. 5, pp. 3328-3331, October 2014.

[4] V. Vaishnavi, R.C. Varshitha, M. Tejaswini, N.R. Biju and K. Kumar, "*Literature Survey on Smart Water Quality Monitoring System*," International Journal of Innovations in Engineering and Science, vol. 3, no. 3, pp. 20-24, 2018.

[5] M. Barabde and S. Danve, "*Real Time Water Quality Monitoring System*," International Journal of Innovative Research in Computer and Communication Engineering, vol. 3, no. 6, pp. 5064-5069, June 2015.

[6] N.Kedia, "*Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project*," Proc. in 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India, 4-5 September 2015.

[7] E. Park, A.P. Pobil and S.J. Kwon, "*The Role of Internet of Things (IoT) in Smart Cities: Technology Roadmap-oriented Approaches*," Sustainability, vol. 10, pp.1-13, 2018.

[8] V.V. Daigavane and M.A.Gaikwad, "*Water Quality Monitoring System Based on IOT*," vol. 10, no. 5, pp. 1107-1116, 2017.

[9] N.A. Cleote, R. Malekian and L. Nair, "*Design of smart sensors for real-time water quality monitoring*," IEEE Access, vol. 4, no. 9, pp. 3975 – 3990, July 2016.

[10] A.J. Whittle, L. Girod, A. Preis, M. Allen, H.B. Lim, M. Iqbal, S. Srirangarajan, C. Fu, K.J. Wong and D. Goldsmith, "*Waterwise@SG: A Testbed for continuous monitoring of the water distribution system in Singapore*," Proc. in Water Distribution System Analysis 2010, Tucson, AZ, USA, September 12-15, 2010.

[11] M. Saraswati, E. Kuantama and P. Mardjoko, "*Design and construction of water level measurement system accessible through SMS*," Proc. in 2012 Sixth UKSim/AMSS European Symposium on Computer Modeling and Simulation, Valetta, Malta, November 2012.