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Smart Water Distribution System

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***Abstract:*-- In most of the water distribution network system, major amount of water losses due to leakage and faulty joints. This paper deals with the design and real-time monitoring of water leakage detection with the help of sensors. The system consists of vigorous and reliable wireless sensor network, which constitute electrical devices along with the Arduino Uno for collection of data from different sensors (Pressure, flow rate, Vibration etc.). Location of leakage and amount of water loses through the water go, identified through the sensors and other collected information are dumped into the cloud through the gateway. Subsequently users can get the data using Wi-Fi module. As soon as a leak takes place, the solenoid valve will automatically close and reduces further loss of water. Implementations of Smart Water distribution network system helps for real-time monitoring and reduces the water losses as well as enhance the water conservation.**

Key Words- Water Leakage, Sensors, Arduino Uno, Distribution system.

INTRODUCTION

Water is one of the basic needs for all living beings. Growth of a city is mainly depending on availability of fresh water resources. Increase in technology, industrialization leads to expansion of city. Immigration of people with different lifestyle leads to ever increasing water demand. In areas where the source of potable water is not available nearby, pipeline is employed to bring the resource to required city and distributed through a network of pipeline.

Improper design and installation of pipes in the distribution system, water hammering, blockages in the pipe and poor quality of material can cause leakages in distribution system and leads to the loss of energy and unable to meet the requirements of people (Minimum of 135 lpcd as per the Bureau of Indian Standards, IS: 1172-1993).

Leakages not only causes water loss but also allows pollutants to enter into water pipeline, causing unhealthy environment and in some cases, it may leads to death due to consumption of contaminated water in leakage areas. Detection of unauthorized connections in the distribution system is difficult because it does not show any signs of leakage rather decreasing the strain and drift.

Proposed Model:
Present study prepared a prototype model to detect leakage in distribution system using sensors. Different sensors installed in the model are shown in fig1.

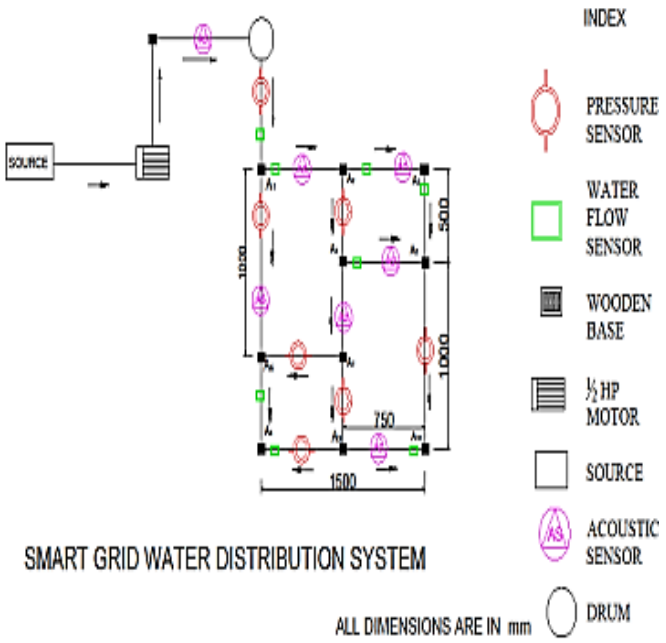

Fig 1: Smart water distribution system with sensors

Different junctions of the distribution networks analysed in the study are shown in table1.

Table 1: Labeling of pipes in water distribution model

Label	Start of junction	End of junction	Length (m)	Diameter (m)
P-1	A-2	A-4	0.5	0.02
P-2	A-4	A-5	0.75	0.02
P-3	A-4	A-7	0.5	0.02
P-4	A-7	A-6	0.75	0.02
P-5	A-7	A-9	0.5	0.02

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METHODOLOGY:-

Generally, water pipes are buried underground, making it difficult to pick out the location of leaks. Because of this, water Leakage has usually been detected when water flows out of the spout pipe, because of massive leaks in pipes and those techniques are used perceive the areas with massive water leakage. Leakage detection using different types of sensors employed in the study, discussed one by one in the following sections.

1. Pressure sensors

• Pressure sensors are named as Pm if the sensor is located on the main pipe and Pd on the distribution pipe. The junctions are numbered as A1, A2, A3 …. N as shown in Fig 1. The range of pressure sensor used in the distribution pipeline is 0-1mbar.

• The pressure sensor connected to water pipe measures the pressure and two of them connected in the different direction of network pipe line which measures the difference of pressure on either side of the pipe.

•If there is any leakage in the system, causes drop in the pressure readings of the sensors.

A pressure sensors work as a transducer, it generate Electrical signal, as the pressure imposed on the pipeline network; this sensor has a sensing element which is provided on the pipe and sensing part has experienced the flow of water in pipe and the pressure carried out will deflect the diaphragm in the strain transducer and deflection of the internal diaphragm is measured and converted into an electrical output; Electrical output converts to pressure sensor data through the Arduino Uno as shown in Fig 2

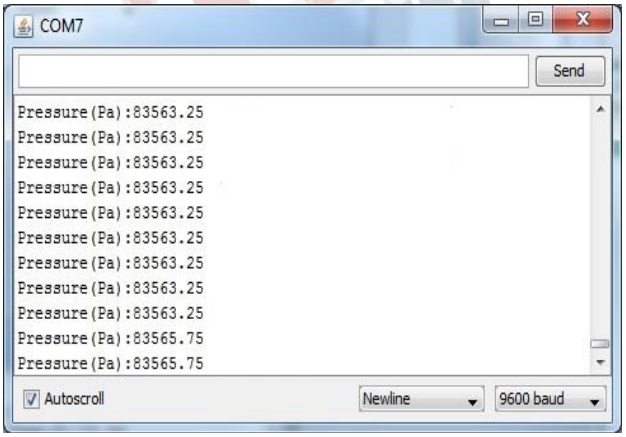

Fig 2: output results of pressure sensor

2. Water flow sensor

Arrangements are same as pressure sensors. Water flow sensor (YF-S201) pressure range in the distribution pipe is ≤1.75mpa and working range 1-30 L/min.

- Fm-flow sensor in the main distribution system
- Fd-flow sensor in the branch distribution system

Connection of different sensors in electric circuit with Arduino is as shown in Fig 3.

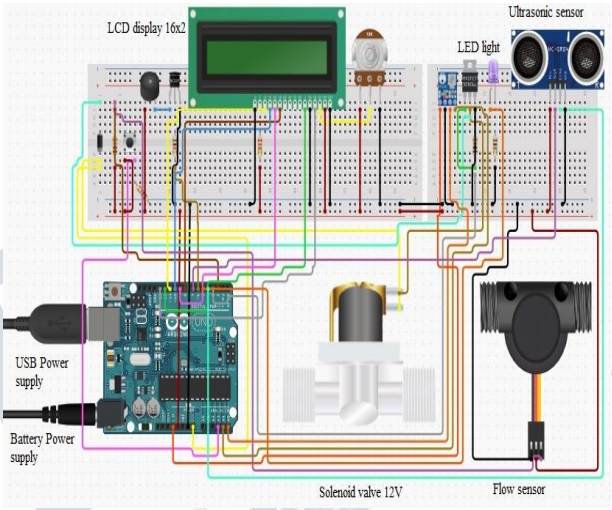

Fig 3: Integrated circuit diagram

After the connection of sensors to Arduino, compiling, uploading is done. In the serial monitoring tab, sensors data can be observed and analysed. Water flow sensor connected to the arduino uno measures the quantity of flow after the code has compelled and uploaded. Output result is as shown in Fig 4 and Fig 5.

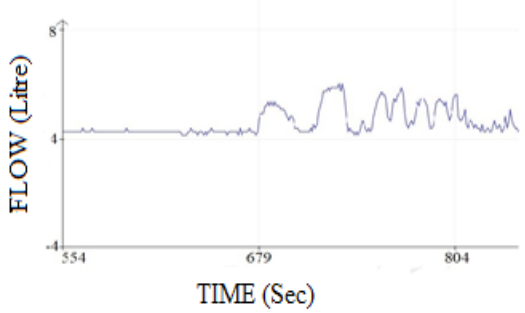

Fig 4 : Water flow output image

After uploading the programme to Arduino UNO, it will give flow results in L/Sec as shown in Fig 5. Variation of flow is shown in Fig 4.

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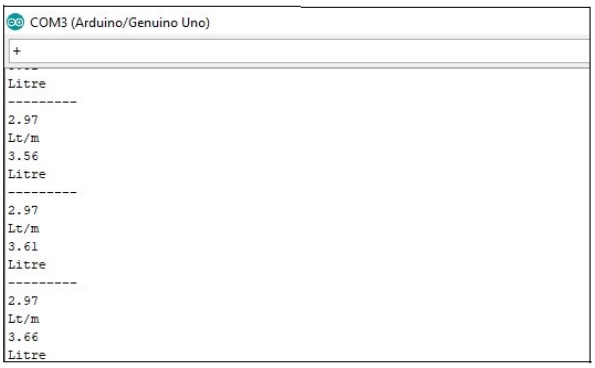

Fig 5: Output of water flow sensor.

3. Ultrasonic sensor

An ultrasonic sensor makes use of sound waves of a selected frequency to detect the distance of an object which encounters at the route of the wave. The range of ultrasonic sensor is 2cm to 400cm or 1 to thirteen feet. It has two openings on its front, one is the transmitter and the other one is the receiver. It sends out an ultrasound signal which passing through the air medium and if there is an obstacle or a material thing, touched in its path, it will be returned to its sender after failing to reach its destination, to the receiver. Leakage and obstruction distance can be calculated by taking into account the travel time and the speed of the sound wave. In the Serial monitoring tab, the Sensors data can be observed and analysed.

Identification of obstructions with passage of ultrasonic waves are shown in Fig 6. According to base line cut off point, leakage can be identified along the direction of flow.

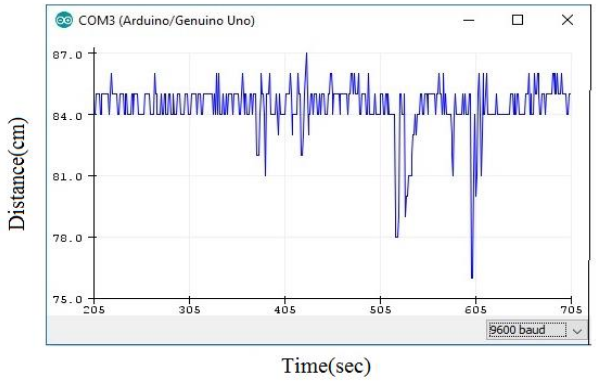

Fig 6: Identification of obstructions by Ultrasonic sensor

4. Sound sensor

The sound signal moves along the pipeline and operator can detect the leakage by investigating the acoustic signal. Frequency and amplitude of the signal are proportional to the amount and size of the leak. Data obtained from the sensor is converted to digital form using a microcontroller. This sensor gives the better approximation to the human perception of relative loudness than the other scale.

5. Vibration sensor

Vibration sensors are used for quantifying, studying linear pace, transhumance and nearness of location. The sensitivity of the vibration sensor stages among 10 and one hundred mv/g.

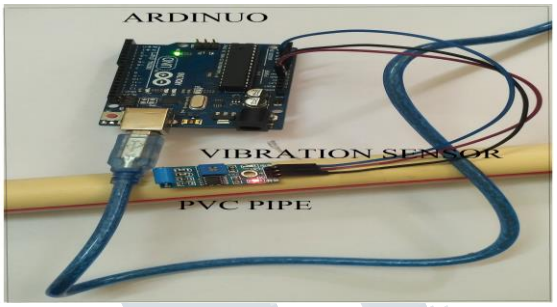

Fig 7: Vibration sensor connected to Arduino

Fig 7 shows the connection of Arduino Uno to vibration sensor. After connecting water pipe to sensor and Arduino, program compiling and uploading in the serial monitoring tab, data can be visualized as shown in Fig 8 and the variation can be observed as shown in Fig 9.:

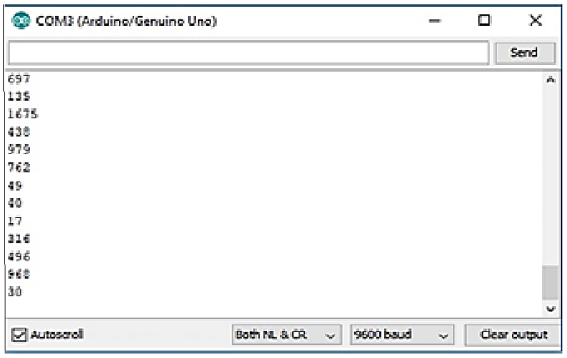

Fig 8: Output of Vibration sensor

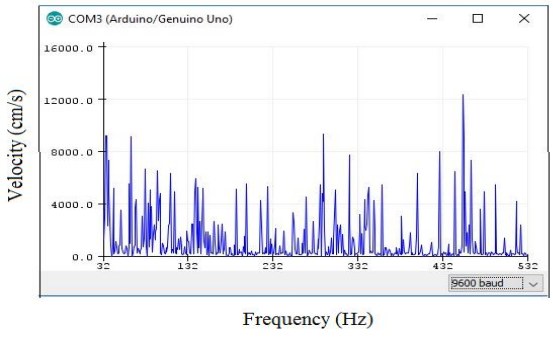

Fig 9: Variation of vibration sensor data

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7. Programming Arduino:

The Arduino is an informal computing platform based on the data processing multimedia. Once the sensor circuit connection has been created, it is required to upload the program to the Arduino Uno. A series of coded software instructions given with reference to each sensor, controls and process the data collected from each sensor. It is a similar physical computing platform, based on the processing multimedia.

Application of sensors in water distribution system, collecting data from sensors, processing and pushing into server or cloud through the gate way, visualization and multiple usage of data can be anlaysed in the following Fig 10.

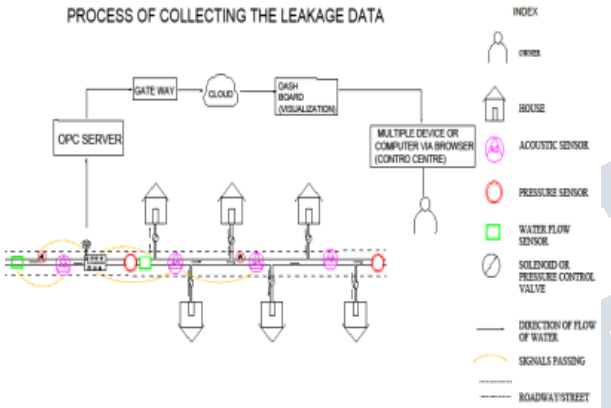

Fig 10: Sensor data collection and communication

CONCLUSION

Sensors deployed on each street of distribution network, collect the data according to the working principle. An analog sensor generates constantly varying data which can be converted into digital form using Arduino uno 1.5.8. Processed data in cloud computing is a low-cost simulation which provides, real-time data to users/consumer at any time with immense coverage and quality.

Any leak between two sensors nodes are successfully detected thereby enabling the authority to respond to the leak at the earliest. Smart water distribution system is more efficient, reliable and accurate.

REFERENCES:

[1] J.M. Muggleton and M. J. Brennan, "Leak noise propagation and attenuation in submerged plastic water pipes," Journal of Sound and Vibration, vol. 278, No. 3, pp. 527–537, 2004.

[2] Milad Gossan, Aidin Ghavamian, Ali Mohammed, Ali Abdulshaheed, "Pipeline monitoring system using wireless sensor network" , International Journal of science and research, volume 13, No 1 , pp25 - 32, 2016.

[3] M A. Ezechina, K. K. Okwara, C. A. U. Ugboaja. "The Internet of Things (IoT): A Scalable Approach to Connecting Everything.", The International Journal of Engineering and Science Vol 4(1), pp 09-12, 2015.

[4] Q. Xu, R. Liu, Q. Chen, and R. Li, "Review on water leakage control in distribution networks and the associated environmental benefits," Journal of Environmental Sciences (China), vol. 26, no. 5, pp. 955–961, 2014

[5] Gopala Krishnan P, Abhishek S, Ranjith R, venktash R and Jai Suriya V "Smart Pipeline Water Leakage Detection System", AICHE journal publication, vol-12, pp16, 2017.

[6] Jayavardhana Gubbi, Raj Kumar Buyya , Slaven Marusic, Marimuthu Palaniswami "Internet of Things (IoT): A vision, architectural elements, and future directions" , Future generation computer system, Vol 29, pp 1645–1660, 2013.

[7] Suman Kumar Choudhary, Ravindra B. Sathe, Arun E. Kachare, "Smart Cities Based on Internet of Things (IoT) -A Review", International Journal of Engineering Trends and Technology (IJETT) – Vol 48,pp 8,June 2017.

[8] M. Mask it, A. Outfield, "Leakage calibration of water distribution networks", Presented at 16th Conference on Water Distribution System Analysis, vol 2, pp 8 (21), 2014.