Framework and Solution For Water Leakage

SOURABH KUMAR, DR. MONIKA SHARMA
Amity Institute of Information and Technology, Amity University, Uttar Pradesh, NOIDA, INDIA

Abstract: Nowadays leakage is a big issue in high rise societies. In this paper we are proposing a leakage detection solution and location method based on community sensors. Wireless sensor networks (WSNs) have been used in military applications mainly because of their accuracy and efficiency. Today, it is considered the first in many civilian applications, such as leak detection. Different technical issues such as energy consumption must be considered for different applications. WSN has recently emerged as an effective solution to water leakage. Water is channeled from water sources such as rivers and lakes to the city. Non-revenue water (NRW) is the amount of water produced and lost before reaching consumers. Leakage can be caused by illegal connections and faulty counters. Keeping in mind that water leakage is a global problem that has become an important issue in many fields, the main objective of the paper is to develop a water leakage and monitoring system using flow sensors using the IoT concept. used to detect leaks and solenoid valves placed in various parts of the pipe chamber, blocking the flow of water until the defective part of the pipe is repaired. In addition, existing authorities are notified wirelessly in the event of a leak.

Key-words: Wireless Sensor Networks, water leakage, IOT

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1. Introduction

Water management plays an important role in society. In general, leakage attracts international attention because it causes water shortage. This not only leads to loss of income but also affects national reserves. In developing countries like India, water loss in the domestic sector due to leakage accounts for about 30-40% of the total flow in distribution. By using a water control system, we avoid water waste, energy consumption and water that is easy to preserve for future generations.

Pipeline drainage systems are responsible for transporting critical materials such as water, oil, and gas. Any pipeline leak can cause huge financial losses and environmental damage. Leaky water pipes allow contaminants to enter the water system, reducing water quality and endangering the health of water users.

Most of the water pipes are buried underground, making it difficult to find a leak. Because of this, water leaks are usually found when water comes out of the ground due to a large leak in the pipe. Leak detection assumes that all leaks are present and visible. Leaks are mainly caused by old and therefore water permeable infrastructure. Since the pipes are not immediately visible or accessible, it is impossible to detect leaks. The loss of water supply forces water agencies to withdraw more water from lakes and streams, paying more attention to aquatic ecosystems.

Once a leak is detected, the water utility must take action to reduce water loss in the water distribution system. Proper placement and maintenance of leaky water pipes in the supply system will reduce these losses. Leaks reduce the reliability of the water supply system. This can cause households and businesses to relocate, find alternative sources of drinking water, and find expensive ways to protect against threats to their water supply.

2. Literature survey

Deepiga and Sivasankari [1] designed a water monitoring system including tank water level sensing, water pollution control and water pipe leakage monitoring. Microcontroller based water level monitoring is used to indicate the water level in the tank to the agent. The detection of leakage in the pipe is calculated by using force sensing resistor (FSR) which results from pressure leakage. It will be indicated by an increase in the LED meter and the sound of water in the pipes that can be heard in headphones. Adsul and Kumar [2] proposed a wireless leak detection system using a variety of sensors and microcontrollers that make the system mobile and non-destructive techniques (NDT). In the system, parameters such as humidity, temperature, pressure, sound detection and gas detection around leaks are detected using Arduino sensors and microcontrollers.

Jayalakshmi and Gomathi [3] proposed the design and implementation of a water leak monitoring and detection system for leak monitoring and detection using wireless sensors. The purpose of the extended system is to detect groundwater leaks for residential water pipes monitored by a personal computer. Daadoo and Daraghmi [4] focused on the use of wireless sensor networks for leak detection in underground water pipes to deal with water dispersion problems. To solve the problem and simplify the leak detection process, the author developed a wireless network system that uses mobile wireless sensors. Miles [5] describes the background theory and practical applications of fiber optic-based technology that uses acoustic Brillouin scattering to detect subtle temperature changes in cables. The paper will present the background physics of the method and present the results of research conducted to detect brine pipe leaks.

Sithole et al. [6] presented an inexpensive Smart Water Meter Device (SWMD) capable of detecting potential leaks. Flow Meter sensors are installed to measure the amount of water consumed by consumers.

Medina et al [7] presented a method based on signal analysis for leak detection in water supply systems. The paper presents feature extraction from pressure signals and their use to detect

changes related to leak initiation. For example, a signal is obtained from an experimental laboratory and its features are extracted from the time domain and the transformed signal. Martini et al. [8] showed that leakage control in the water distribution network represents an important problem for all utilities related to drinking water. The work is related to the detection of water leaks using vibration monitoring methods. The aim of the paper is to develop an automatic early detection system for leaking leaks in service pipelines.

Choi et al., [9] proposed a new leak detection and location method based on vibration sensors and a general correlation method. The paper explains the theoretical variance of the time difference estimation error by summarizing in the discrete frequency domain and finding the optimal regularization factor that minimizes the theoretical variance in practical water pipelines.

Kei [10] describes a service that installs sensors at arbitrary intervals on water pipes to capture vibrations caused by water leaks, transmits the received data to a cloud computer through a wireless network or public telephone network, and locates the leak based on the results data analysis.

Oliver and Scott [11] proposed a sensor network design method that generates human-readable rules for leak detection. It also finds optimal locations for flow sensors for specific systems and operating scenarios. This method is shown to provide reasonably accurate predictions in the real world of unknown parameters.

Nakhkash and Mohammad [12] discussed the possibility of using ground penetrating radar (GPR) to detect leaks in buried water pipes using electromagnetic simulation. Model and soil configuration of GPR Finite Difference Time Domain (FDTD) system. The paper reports response signatures and mixing characteristics of groundwater in GPR data. These results help identify water leaks and confirm the usefulness of GPR in detecting water leaks.

Araujo et al [13] described a model to support a decision system related to adjusting the quantity, location and opening of control valves in a system designed to reduce the main system pressure and consequently the leakage rate. The research work provides a solution that allows optimizing the number and location of valves simultaneously, as well as adjusting the valve opening for longterm simulation depending on the characteristics of the system. The Environmental Protection Agency Network Model (EPANET) was used for hydraulic network analysis, and two business models were developed based on genetic algorithm optimization methods for pressure control and leakage reduction. In these two modules, the method guarantees adequate technical performance, requiring a global evaluation of the system for different scenarios.

Lin et al [14] developed a wireless sensor network mainly targeting military applications. However, in recent years, many civilian applications have emerged, such as inventory management, product quality control, and disaster zone monitoring. Power consumption, radio transmission models, routing protocols, sensors, etc. for various applications. Various technical issues such as This paper proposes a specific application for wireless sensor networks, especially for water distribution network monitoring systems. It also proposes a possible communication model for water distribution control systems and describes a channel measurement approach to determine an appropriate path loss model. The accuracy of the proposed measurement approach was verified using a two-beam model with flat ground.

Haksenas [15] proposed a method for acoustic monitoring of leaks in buried water distribution pipes. The basic principle is that water escaping from a leak in a pressure pipe produces an acoustic sound, and this sound contains information that hopefully indicates whether or not there is a leak. Acoustic leak detection methods are mainly based on correlation analysis, where sensors are installed on each side of the leak. The two received acoustic signals are correlated, and the difference in arrival time indicates the location of the leak. In theory, it can provide very high accuracy for metal pipes. The main weakness is the lack of generality. Correlation methods almost always fail to provide accurate predictions when applied to plastic pipes. Research involves using and evaluating the pulse-echo method to detect leaks. This method has been used for years to diagnose power lines. The basic concept is to analyze the received signal to detect traces of explosions and specific leaks. Due to the dynamic disturbance in the water pipe near the point of leakage due to leakage, it is expected to observe the Doppler shift in the modulated signal wave. The report begins with an introductory section to provide an overview of the problem of leak detection. It is followed by a theory section that describes a model for predicting the sound field produced by the reflection of acoustic waves from a moving reflector. The experimental part covers the application of this method to the urban water supply system and the measurement results. Then the signal processing section includes data analysis and final results.

3. Proposed Work

Determining pipe permeability is influenced by soil type, density, depth, and surface cover. Water pressure, pipe material and diameter greatly affect detection accuracy due to frequency interference.

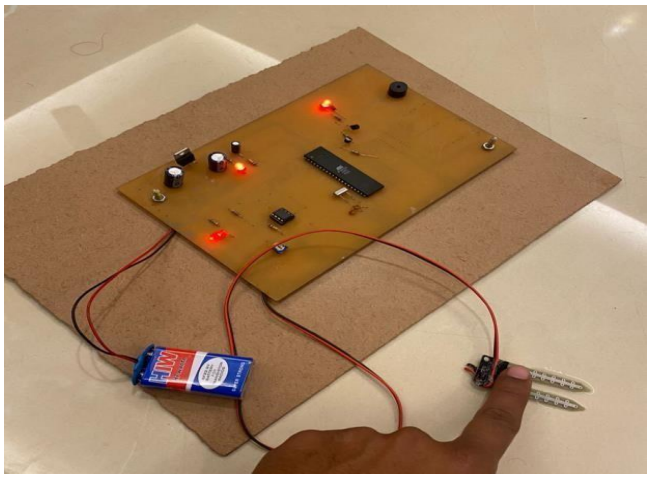


Figure 1. Moisture Sensor Module

The pipe structure consists of several branches and nodes as shown in Fig. 1. Such a structure can be divided into a basic structure consisting of two branches and three points. Where two or more pipe branches are located, a microcontroller is placed that receives data from sensors placed on each adjacent pipe. The water flow rate in the system is measured by water flow sensors in the inlet and outlet pipes. This flow sensor is in turn connected to the microcontroller unit. The sensor does not interfere with the water flow, it only collects flow rate data. A solenoid valve is an electromechanical device used to control fluid flow. A solenoid coil works like a valve operated by humans. If a certain amount of liquid flow is needed, it opens the valve as needed, and if no flow is needed, the valve closes completely. The solenoid valve will be connected with the relay module to the microcontroller. Microcontrollers communicate with each other wirelessly. If there is a leak in the pipe, there will be a significant difference in the flow rate measured by the two monitors. It can be used to detect leaks.

There are four main actions to reduce leakage and they are pressure management, active leakage management, rate and quality improvement, and pipeline repair and renewal. Older detection methods, which depend on periodic checks by maintenance teams, have many disadvantages, such as:

1. Strong men demand.
2. Does not provide real-time monitoring of pipelines.
3. Causing great economic losses.
4. Cause environmental pollution.

The underground cable network for communication suffered damage and was very expensive. wireless network on the other hand

hand, safe and more efficient. It also provides flexibility and simple system deployment, but underground wireless communication has not yet been developed and implemented. However, wireless communication can be used to send data over long distances to reach remote control points. The microcontroller continuously monitors the flow rate when the system is in flux. The leak detection algorithm works in such a way that when the difference in flow rate between two adjacent sensors is greater than the calibrated threshold value, the leak is detected by the microcontroller as shown in the figure. The difference in streaming speed is sent to the Cloud via the Wi-Fi module. When a leak is detected, an alert or warning is triggered and a message is sent to the appropriate authorities.

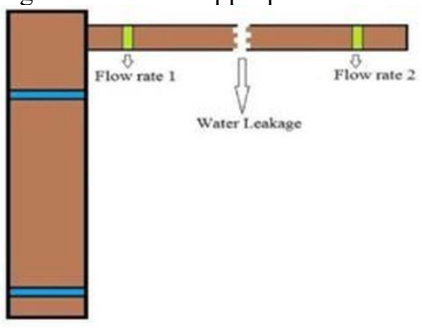


Figure 2. Flow rate

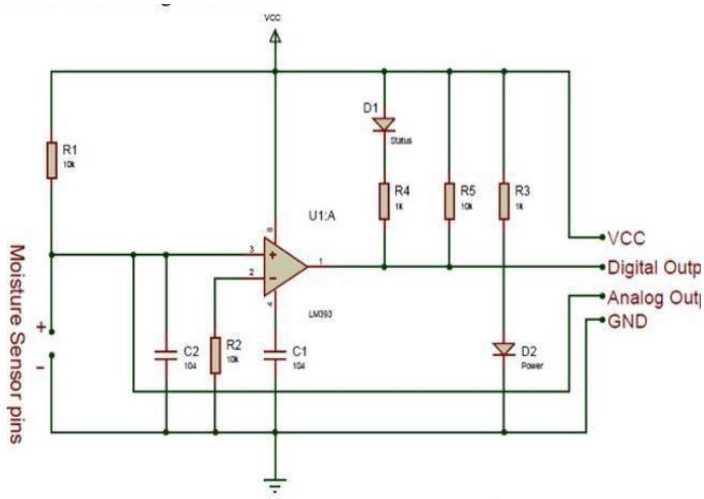
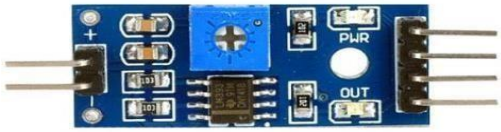


Figure 3. Block diagram Soil Moisture Sensor Module



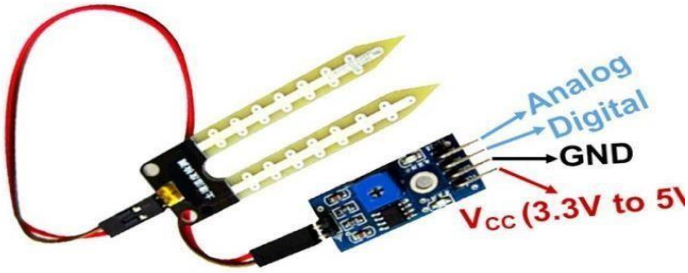


Figure 4. Soil Moisture Sensor Module

The importance of the soil moisture sensor module in water leakage detection is to detect changes in soil moisture, indicating water leakage or overwatering.

4. Conclusion

Water leakage is a serious problem in the world that needs to be solved immediately. Otherwise, it will cause economic losses and large raw materials. In this paper, we presented four WSN technologies for leak detection. In addition, the proposed method can contribute to the development of automated leak management solutions that collect leak data, warn of leak hazards, and provide information on specific leak locations. From this study, it is clear that current leak detection methods have different accuracies, deployment costs, and application environments. However, combining several leak detection methods to form a hybrid system is common and recommended. From this review, it is understood that existing methods can detect explosive leaks at a certain level.

However, there is uncertainty in its application in detecting background spectrum leakage. In large-scale pipeline networks, such as in water distribution networks (WDN), background leaks are often hidden and difficult to detect compared to pipeline bursts, which are the focus of many research efforts. As a result, current leak detection methods, which use signal processing/analysis to detect sudden changes in pressure and flow in pipes to detect leaks, are not effective for detecting background leaks in WDN and do not meet the need for largescale detection. leaking water distribution network. More research should be devoted to this type of leak, as a greater percentage of water loss is caused by this type of leak.

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