Water Leakage Detection and Location Identification using IoT and Cloud Interface

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Abstract

Water loss due to leakage in water supply pipelines needs to be addressed. This paper presents a system for water leakage detection by using sensors in pipelines and transfer of the data to the cloud. Two sensors attached to the pipelines are used to capture leakage detection through variation in pressure. They record water pressure when water flows through the sensors. A laboratory set-up was developed and tested for water leakage detection.

Keywords: *Distribution Network, Leakage Detection, Sensors, Water Distribution*

1.0 Introduction

Internet of Things (IoT) and wireless communication are useful to provide solutions different complex problems. Water leakage long distance pipelines can be detected using IoT solutions. IoT enabled systems can be implemented for water leakage detection, monitoring and controlling. Such a system is shown in Fig. 1.

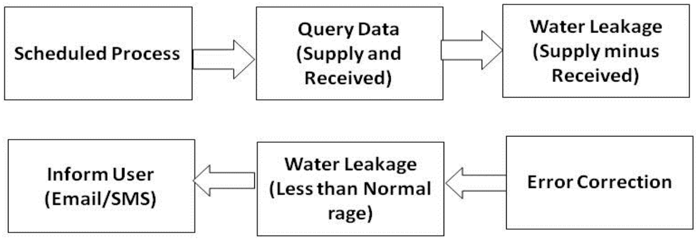

Fig. 1. IoT based system architecture for leakage detection

Major challenge for water distribution authority is managing damages in water supply lines due to aging of pipelines [1]. Maintenance of water distribution networks has to be undertaken in a cost effective manner. There are several methods for monitoring water distribution networks and measuring variations in water pressure in pipelines using sensors for detecting leakage and through IoT solutions [1-3] and it opens-up several domains of research in reducing the overheads in infrastructure maintenance. These monitoring systems [4-5] adopt a damage identification strategy to monitor the performance of water supply

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pipes. It involves leakage detection [5-7], extraction of damage-sensitive features.

Newer technologies, wireless sensor networks and the Internet based solutions can decrease the cost of maintenance [8] by installing improved flow sensors in water distribution networks. A hydraulic model embedded with the necessary application software records the change in pressure sensor data within the supply pipe [9]. This creates a file of pressure sensor data which may be observed to detect the leakage in the near future. Leakage detection based on prediction [10] uses classifiers that function based on learning algorithms. The output of these classifiers is a human-readable code, which helps to locate the leakage and magnitude of leakage occurred in pipeline. The main objective of this work is to develop an IoT based solution for leakage detection and location identification in water supply pipelines.

2.0 System Details

Most of the domestic or office establishments have single water supply and multiple receiving inlets with traditional watermeters. Single supply end and multiple receiving inlets are common even in multistoried apartments. Traditional watermeters collect data only at the supply end which is generally read once a month for billing and cross checking of the data is not in place. Incidence of water leakage due to broken pipes is not detected. The proposed methods uses two sensors for each pipeline, one to monitor the supply and another to monitor the data which is updated periodically to the smart water meter application on cloud. A process runs on the cloud to monitor the data and raise alerts whenever any discrepancies are found. The system monitors water supply data in real-time and raises email alerts in case of discrepancy (Fig. 2).

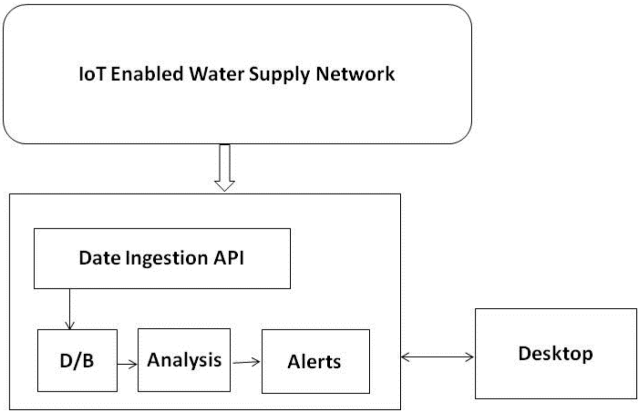

Fig. 2. System Architecture: IoT enabled water leakage detection system

Two processes are developed to monitor water flow data using YF S201 flow sensor (Fig. 3), one for measuring water flow at supply end and another to measure water at the receiving end. Both the processes upload data periodically to smart water meter application hosted on the cloud. Flow in the pipeline is measured using flow sensors which are equipped with pin-wheel sensors to monitor the flow. The sensors are connected in-line to the water flow, to monitor the pressure with every revolution that occurs in pin-wheel. The sensors provide a digital output with varying pressures.

Fig. 3. Flow sensor (YSF 201)

3.0 Results and Discussion

Performance of water leakage detection system is tested in the lab. The performance is evaluated using two sensors. The output of these sensors is used to detect and recognize the exact location of water leakage in the supply pipe. In the lab set-up, performance of the proposed system was tested for detecting water leakage and to identify the location of the leak within the supply pipe. The set-up consists of a section connected with a 40 mm plastic pipe and with a hole of 5 mm, to simulate the leakage at a section. Water is circulated through the pipe with the known pressure. Initially, the hole is closed with the rubber strip, which will pop-out when the water pressure increases, resulting in water leakage from the pipe. In order to detect the leak and to pin-point the location of water leakage, two sensors attached to the end of the pipe sections, one at the start (Sensor -I - at the water inlet) and another at the end (Sensor-II - at the water outlet). Each sensor was housed over the pipe firmly using an SS clip which records the water pressure. Burst of water, from the hole created in the supply pipe, results in pressure drop sharply (Fig. 4). Pressure profiles of sensor –II indicate the leak as downstream in the graph. Output of these sensors showed gradually increased at the incidence of leakage due to pipe burst. Difference in sensor profile or output is used to determine the location of the water leakage.

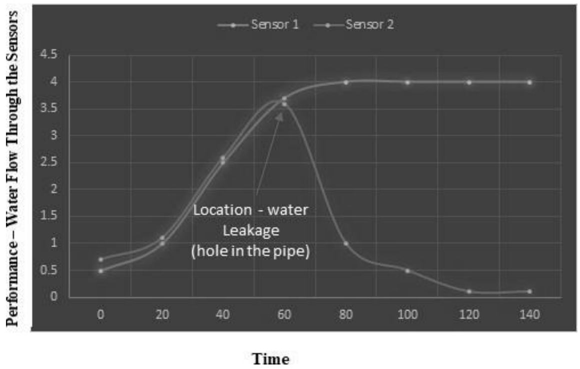

Fig. 4. Results of water leakage detection system

4.0 Conclusions

Internet of Things enabled water leakage detection system was successfully implemented. The sensor data indicated leakage and its location in the water supply line. Two sensors were attached to the end of the pipe sections, one at the start - at the inlet and other at the end at the outlet. The sensors record water pressure when water flows through the sensors.

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