

IoT Water Distribution Monitoring

Yong Saan Cern^{1*} & Lim Yi Hang²

¹*Sekolah Menengah Jenis Kebangsaan Katholik, Jalan 10/3, Seksyen 10, 46000
Petaling Jaya, Selangor, Malaysia.*

²*Wesley Methodist School Kuala Lumpur (International) 185, Jalan Lima, Sentul Selatan,
51000 Kuala Lumpur,
Wilayah Persekutuan Kuala Lumpur, Malaysia.*

**Corresponding author (only one author): yong.saancern@gmail.com*

Abstract

Water is one of the most important substances on earth. All plants and living things must have water to survive. Providing and distributing adequate quality and amount of water is the top priority globally. Statistics shows 36% of pipe water leakage in Malaysia has a large impact to the environment and social. We invented an innovative idea of early detection of water leakages using Internet of Things (IoT) that will help to solve water wastage in the public water system. This will save time, cost and most importantly save the environment. We use volumetric flow rate sensor to detect specific leakage area in the water pipe network. This technology can be installed in all main water pipe distribution and will help constantly monitor the water pipe flow rate. Each IoT water pipe monitoring system will have its exact GPS coordinate and are mapped to open source mapping in Node-Red. We use Node-red to collect data from the pipe and live stream all the data to control room for monitoring.

Keywords: Water distribution, Water pipe flow rate, Internet of things, Node-red

1.0 Introduction

Water is one of the precious resources on earth. All plants and living things need water for survival. Most countries have taking action to address the issue. According to United Nation Sustainable Development Goal 6, 25 percent people is likely to faced chronic or recurring freshwater shortages in the coming thirty years. In 2015, estimated 5.2 billion people, about 71 percent of the global population had safely managed drinking water. However, remaining 844 million people still struggle to get adequate drinking water in daily life [1]. Too many people still lack access to safely manage water supplies and sanitation facilities. Water scarcity, flooding and lack of proper wastewater management also hinder social and economic development.

Based on research data, the common problems arises in water supply distribution system are unaccounted for water which usually pipe leakage or wastage of water. In addition, degradation of quality of water and reduction in carrying capacity due to water pipe aging and deterioration. Inadequate pressures at tail ends of the system affected water supply and consumer experienced [2]. There is a concern worldwide that water distribution systems are causing phenomenal water losses due to aging and deterioration, while the demands on these systems are ever increasing.

Losses from water distribution systems are reaching alarming levels in many towns and cities throughout the world [3]. This suggested an efficient and sustainable water management system is necessary. In Malaysia, more than 4.27 billion litres of treated water which enough to fill more than 1,700 Olympic-sized swimming pools or keep Perlis going for 53 days are leaking out of the country's ageing pipe system every day. Statistics shows 36% of pipe water, about 5.69 billion litres a day leakage in Malaysia in 2013 [4]. It causes huge monetary lost and has a large impact to the environment and social. According to Syabas Water Company, the internal plumbing systems and distribution pipes of most houses or buildings have been installed using Galvanized Iron Pipe (GI Pipe) or other poor-quality pipe materials. The life span of G.I. pipes is generally between five (5) to seven (7) years. As these pipes get older, problems such as rust and incrustation (blockage) will occur, affecting the quality of water as well as the water pressure. In many cases, these pipes also develop underground leakage which remains undetected until the customer receives a high-water bill. This results in wastage of water as well as financial losses [5].

In Malaysia, many techniques are used for water pipe leak detection. Among the commonly used conventional method is the mechanical listening stick. Others unique approach of leak detection will be applied depending on different characteristics of pipe materials, soil condition, and site limitation. However, there is no internet of things technology been applied to detect water leakage to help prevent water losses in the early stage. We believed that application of ICT technology will surely help to manage the system more effectively. Our objective is to detect water leakage using IoT earlier. Our project is using ICT technology to detect water leakage in public pipe distribution. This invention can help to minimise non-revenue water to prevent shortage of fresh water supply. This is cost effective and environmentally friendly option to solve water leakage issue in the public water system.

2.0 Methodology

The technology is an internet of things (IoT) based water pipe monitoring throughout 24/7 without human supervision constantly checking at the wide public pipe distribution. Water flow rate is detected using Flow Rate Sensor connected on the Flow Sensing Pipe installed on the main pipe. The Flow Rate is constantly monitored by Arduino Nano. The Water Flow Rate will be constantly tracked and data log by Arduino Nano. Arduino Nano will send serial communication to Raspberry Pi which is connected to the Internet either. Raspberry Pi will process the data using Node-Red IoT from Arduino's data and alerted whenever that water pipe distribution has leakages. This technology can be installed in all main water pipe distribution and will help constantly monitor the water pipe flow rate. Each IoT Water pipe monitoring system will have its exact GPS coordinate and are mapped to open source mapping in Node-Red.

In our project, we will focus on the water flow rate in the pipe using the flow rate sensor. The water flow meters work by measuring the speed of water flowing through the pipe that causes a turbine to rotate. The volumetric flow rate of the water is proportional to the rotational speed of the blades.



Figure 1: Flow rate sensor

Flow rate sensor is connected on the flow sensing pipe installed on the main pipe. The flow rate is constantly monitor by Arduino Nano.

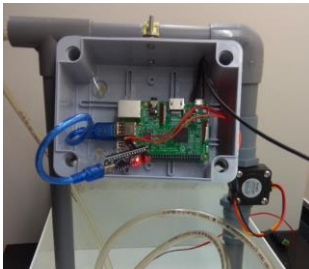


Figure 2: The flow sensing pipe

Flow Sensing Pipe is installed on the main pipe. It is connected with Flow rate sensor to detect water flow rate.



Figure 3: Raspberry Pi and Arduino in IP66 Enclosure.

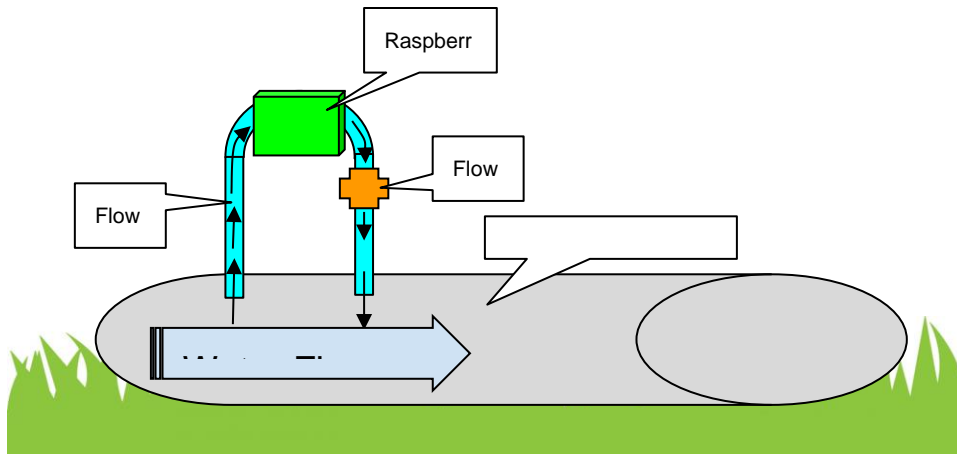


Figure 4: The working model of the Flow Sensing Pipe installed on the water pipe distribution.

3.0 Results and Discussion

In our project, we will focus on the water flow rate in the pipe using the flow rate sensor. Data will be gathered to study of the trend of the water flow rate of a region and detect the pipeline distribution that has risk of potential leakages over the common public usage. This will allow a more accurate assessment of distribution pipes for closure and major repair. Additional data can be used to analyse the water distribution pressure which can be used to improve public water delivery from low pressure due to high water consumption and improve overall public satisfaction on water delivery.

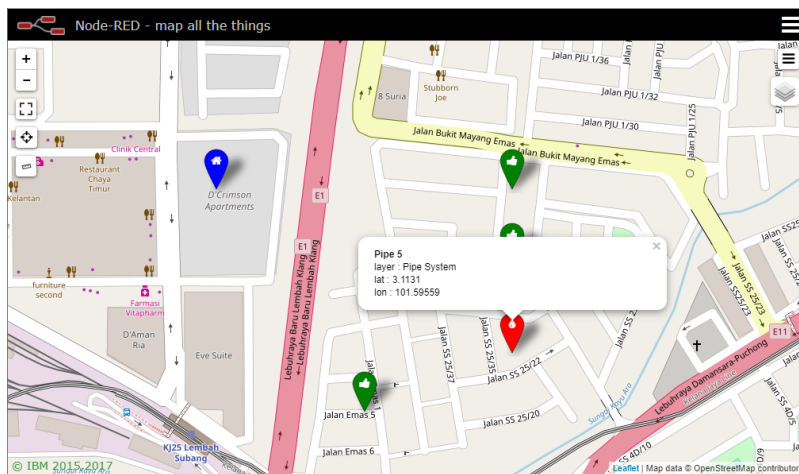


Figure 5: IoT Map location showing the exact location of water pipe distribution (*green icon for good pipe and red icon for the leaky water pipe distribution*)

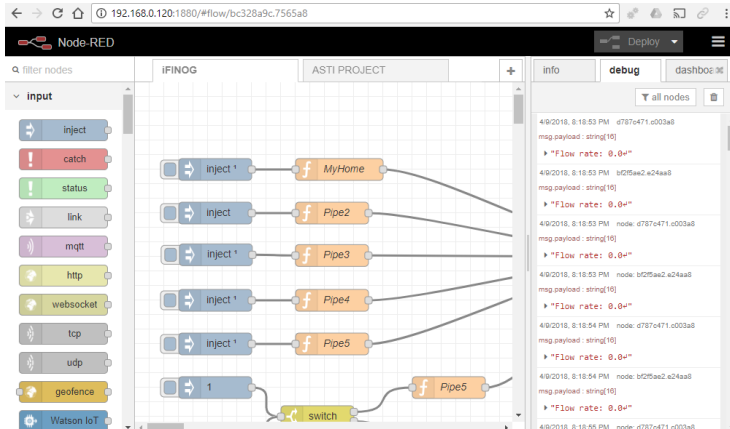


Figure 6: The IoT Water Leak Monitoring System on Node-Red for 24/7 Monitoring

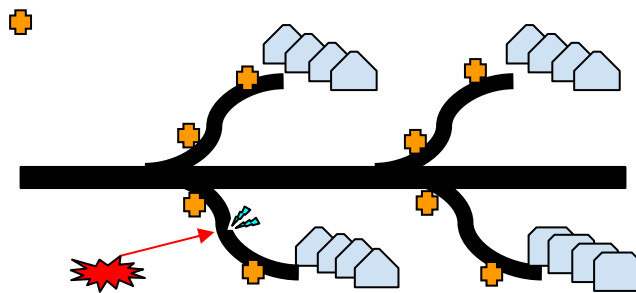


Figure 7: Water Pipe Distribution in a Community installed with IoT Water Flow Monitoring

Figure 5 shows the internet of things map of the water pipes location. The exact location of water pipe distribution can be easily monitored with live update with map location. The IoT Water Leak Monitoring System is supported by Node-Red for 24 hours continuously monitoring. Node-Red is selected as a programming tool for this project since it can wire the application program interface together with the hardware devices such as Arduino. In Figure 5, there is a red indicator showed that the pipe 5 has error. The location of the pipe 5 can be identified in Figure 7 since the whole water pipe distribution in a community is provided.

4.0 Conclusion

Our project will be able to provide pipe water leakages detection in a large-scale area and allow live data to be monitored online. IoT Water Flow monitoring system will ensure smart water management improvement through IoT water sensors which are installed at various locations in

the IoT water system to sense any leakages or other malfunctions. It can be pre-configured into a complete IoT Solution for water industry which can be implemented for various cases. The IoT smart water management system can reduce water management cost, resulting in better revenues with lower costs. This system also provides opportunities to municipalities to reduce operational costs around construction, maintenance, and more. It's time to consider a smart water management system which spans across every part of the water cycle—from sourcing, treatment, distribution, consumption to reclamation. A smart water cycle which is reliable and robust data are delivered through a smart IoT water utility network.

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