Creating a Sustainable Smart Water Leakage Detection System using IoT

Ravikiran K1*, Shekhapur Tukaram1, K HemaSaiKiran1, Afridhi1, P. K. Abhilash1, Farah Maarfi2

1Department of Information Technology, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, Telangana, India
2School of Applied and Life Science, Uttaranchal University, Dehradun, 248007

Abstract. Water pipe spillage, especially in drinking water frameworks, could be a noteworthy sustainable issue universally, driving to the wastage of valuable assets. Recognizing the significance of water for all shapes of life, it gets to be pivotal to create sustainable arrangements to address this issue. The aim of this venture is to form an Online of Things (IoT) based framework for water spillage discovery utilizing water stream sensors and an Arduino board. The concept behind this extend is to degree the sum of water provided from the source and compare it with the amount of water gotten at the destination. In case these two measured values are rise to, it shows that there's no water spillage within the supply pipes. Be that as it may, in the event that there's a error between the supplied and gotten water volumes, it recommends that there's a water spillage some place within the pipeline framework. Begin by getting the specified materials, such as water stream sensors, an Arduino board (such as Arduino Uno), jumper wires, a control supply, and other supporting elements. Interface the water stream sensors to the Arduino board utilizing jumper wires. Guarantee appropriate wiring and network to precisely the degree the water flow. Create the computer program: Utilize the Arduino IDE (Coordinates Advancement Environment) or a appropriate programming environment to type in the code for your model. The code ought to empower the Arduino board to perused sustainable information from the water stream sensors and perform the fundamental calculations to compare the provided and gotten water volumes. Conduct calibration tests to guarantee exact estimations. You'll be able do this by comparing the readings from the prototype system with known water amounts to set up a reference point. Screen the estimations and watch if any disparities between provided and gotten water volumes show potential leakage. Implement real-time monitoring and cautions (discretionary): To improve the system's functionality, we'll be able to consolidate real-time observing and cautions. It is worth noticing that this model show serves as a confirmation of concept. Executing such a framework on a bigger scale would require contemplations such as arrange network, information transmission, and integration with a centralized observing framework.

* Corresponding author: ravikiran1606@grietcollege.com
1 Introduction

Our proposed smart water leakage detection system aims to overcome the limitations of the existing manual inspection methods by offering an automated, sustainable and proactive approach to detecting water leakage [1,2,3]. The system combines the power of microcontrollers, sensors, and an OLED display to provide real-time monitoring, accurate detection, and timely alerts; a sample of IoT is as shown in the figure.

Fig. 1. Importance of Internet of things. [2]

The system keeps track of the number of water detection events from each sensor. This real-time monitoring allows for accurate measurement of the extent of leakage. The counts are displayed on the SSD1306 OLED display, providing users with immediate feedback on the status of each sensor. By comparing the counts from each sensor, the system determines if there is a significant difference that indicates water leakage [4,5,6,7]. In such cases, an alert message is triggered on the OLED display, notifying users of the potential leakage. This enables prompt action and minimizes the time taken to address the issue.

2 Literature Survey

A literature survey on smart water leakage detection systems reveals several significant advancements and research efforts in the field. Various studies have focused on developing innovative technologies and methodologies to detect and prevent water leakages efficiently[18,9].

Researchers have explored the integration of different sensors, such as flow sensors, pressure sensors, acoustic sensors, and moisture sensors, to detect anomalies in water flow, pressure changes, unusual sounds, and moisture levels that indicate potential leakages. These sensors provide valuable data for real-time monitoring and enable timely detection of leaks[9,11,12].

Furthermore, studies have highlighted the importance of data collection, analysis, and processing in smart leakage detection systems. Advanced algorithms and data analytics techniques, including machine learning and artificial intelligence, have been employed to analyze sensor data, identify patterns, and differentiate between normal water usage and leakage[13,14,15]. This helps in reducing false positives and improving the accuracy of leak detection.

To ensure prompt action and minimize water loss, alarm and notification systems have been developed to alert users, facility managers, or relevant personnel when a leakage is detected[16,17,18]. These systems employ various communication channels, such as
mobile apps, emails, and SMS, to deliver timely notifications and facilitate quick response and repair.

3 Methodology

The proposed methodology detects water flow rates at both the sensors. If both the water flow sensors have the same reading then it is considered as there is no leak in the system. And threshold value is included to be safe from minor errors[19,20,21,22,23] Figure 2 represents the architecture diagram that shows the actual flow of execution of the methodology[1,24,25,26].

![Architecture Diagram](image)

Fig. 2. Architecture diagram of the proposed system

3.1 Libraries used:

**Arduino.h**

- Pin and I/O Operations: The library includes functions like pinMode(), digitalWrite(), and digitalRead() to control the state (input/output) and read/write values to digital pins on the Arduino board.

- Analog Input/Output: It provides functions such as analogRead() and analogWrite() for reading analog input values from analog pins and generating analog output signals using pulse width modulation (PWM) on specific pins.

- Time and Delay: The library offers functions like millis(), micros(), delay(), and delayMicroseconds() for time-related operations, including retrieving the current time, generating delays, and precise timing.

- Serial Communication: Arduino.h provides functions like Serial.begin(), Serial.print(), and Serial.read() to establish and communicate with the serial port, enabling communication between the Arduino board and other devices via a UART (Universal Asynchronous Receiver/Transmitter)
Asynchronous Receiver-Transmitter) interface.

- Interrupts: The library includes functions and macros to handle interrupts, such as attachInterrupt() and detachInterrupt(), allowing you to execute specific code when an external event or interrupt occurs.

- Math Operations: The Arduino.h library provides common math functions like min(), max(), abs(), constrain(), map(), and random(), which are helpful for performing mathematical calculations in Arduino sketches.

- Utility Functions: It includes utility functions like millis(), micros(), randomSeed(), and EEPROM functions for EEPROM read and write operations.

### 3.2 Algorithms

**Input:** Water inflow  
**Output:** Leakage or not

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two water flow sensors has to be intilized</td>
</tr>
<tr>
<td>2</td>
<td>Place one at pumping water tank and second one at destination (house)</td>
</tr>
<tr>
<td>3</td>
<td>Water flow between the source and destination</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>void pulseCounter()</td>
</tr>
<tr>
<td></td>
<td>}</td>
</tr>
<tr>
<td></td>
<td>// Increment the pulse counter</td>
</tr>
<tr>
<td></td>
<td>pulseCount++;</td>
</tr>
<tr>
<td></td>
<td>}</td>
</tr>
<tr>
<td></td>
<td>void pulseCounter1()</td>
</tr>
<tr>
<td></td>
<td>}</td>
</tr>
<tr>
<td></td>
<td>// Increment the pulse counter</td>
</tr>
<tr>
<td></td>
<td>pulseCount1++;</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>flowRate = ((1000.0 / (millis() - oldTime)) * pulseCount) / calibrationFactor;</td>
</tr>
<tr>
<td></td>
<td>flowRate1 = ((1000.0 / (millis() - oldTime)) * pulseCount1) / calibrationFactor;</td>
</tr>
<tr>
<td></td>
<td>difference = flowRate - flowRate1;</td>
</tr>
<tr>
<td></td>
<td>if(difference&gt;2)</td>
</tr>
<tr>
<td></td>
<td>{digitalWrite(led, HIGH); // turn the LED on (HIGH is the voltage level)</td>
</tr>
<tr>
<td></td>
<td>delay(1000); // wait for a second</td>
</tr>
<tr>
<td></td>
<td>digitalWrite(led, LOW); }</td>
</tr>
<tr>
<td>6</td>
<td>Based on step 5 the light will on (if water leak) or of (no water leak)</td>
</tr>
<tr>
<td>7</td>
<td>It will send to mobile app for notification</td>
</tr>
<tr>
<td>8</td>
<td>Step 6 to step 7 will continue for ever.</td>
</tr>
</tbody>
</table>
4 Result Analysis

Fig. 3. Sample results

Figure 3(a) shows the results at the starting of the system. Here at the initial stage the two flow sensors show the values as zeros, it means that there is no water flow at the source and destination. After system is on there is a water flow at the both sensors, here if the both values are same it means there is no water leakage, if the value of the first sensor is greater than the second sensor then there is a water leakage and we can give an indication of light on and also we can send the notification through mobile application.

5 Conclusion

A smart water pump using IoT (Internet of Things) has advantages and significant benefits in terms of early detection, efficient maintenance and water savings. Leveraging the power of IoT technology, the system detects leaks and wastewater in real time, enabling fast repairs and preventing further damage. One of the main benefits of the Intelligent Leak Detection System is that it can continuously monitor the water level and pressure in different parts of the home or property. This allows the system to detect small or irregular water samples that may not be detected during normal inspection procedures. The system will help reduce water loss and prevent property damage by detecting water leaks in a timely manner contributing to sustainable environment. In addition, the integration of IoT devices and sensors allows for remote monitoring and control of water leaks. Users can access information in real time and receive instant notifications on a smartphone or other connected device.

References


aggregation in wireless sensor networks: Combining grey model and Kalman filter,”


