Intelligent Water Distribution & Monitoring System

1. INTRODUCTION

To safeguard India's economic and social prosperity, it is very crucial that enough resource is available to meet the necessity of agriculture, industries, and the domestic sector in the upcoming years. As the available resource of the country is presently witnessing rapid growth, management of freshwater resources becomes the more important. Unfortunately, inadequate water planning, lack of water, and deficient of implementation of desired measures have created a difficult to-manage situation. As a result, a current rating scenario of resource scarcity is gradually flattened in India. Inadequate notice to water conservation, regulation in water use, water reuse, groundwater recharge, and eco-system sustainability. The scarcity of water is already apparent in numerous parts of India, fluctuate in scale and force at inconsistent times of the year. Man power is always needed to control the distribution of water from one area to another area. The water quantity is not monitored and it is distributed as unlimited to the consumers. Extreme contest among water users agriculture, industry and domestic sector. This situation is the result of natural circumstance and human activity.

1.1 Overview

The system initially monitors the water availability in the storage area like water tank and when the water level comes below the threshold level, it enables the motor to fill the storage tank. This system can be automated using the Internet of things.

1.2 Purpose

Main task of the water distribution system is to maintain the water in the tank and also generate the water bills to the individual households which involve human efforts.

2. LITERATURE SURVEY

2.1 Existing Problem

There are two broad classes of related work: (a) Infrastructure monitoring for activity classification and maintenance, and (b) water flow rate measurement techniques. Infrastructure provides useful behavioral information about its inhabitants and often times this information can be extracted through simple interfaces and means. For example, Patel monitors the electrical noise within the powerlines of a house. They exploit the fact that each appliance introduces a unique noise signature. By detecting and identifying this signature, they can infer if an appliance is on or off but not its actual power consumption. Fogarty investigated monitoring of the plumbing system by using microphones on pipes to infer water activity in a household. Both systems are easy to install but employ complex calibration mechanisms in order to learn the detection patterns. Though these systems capture user behaviour, we consider them incomplete for conservation because they do not estimate actual consumption numbers. At a larger scale, cities are struggling with the maintenance of aging water distribution and treatment systems.

Stoianov describes an interesting prototype sensor network that can monitor different water characteristics in realtime. In a lab setup, they demonstrated how one can detect a water leak in a pipe, by analyzing the frequency spectrum of an accelerometer. Even though they use similar hardware, Stoianov's system has a completely different goal and uses a different mathematical approach. Methods to measure the water flow rate, or more generally the flow of liquid in pipes, are of great interest to many fields. For example, chemical processes often require precise control over fluid flow, agricultural irrigation networks need monitoring to avoid over-watering, and utility companies deploy inline water flow meters for billing purposes. The methods could be divided into two categories: (a) open channel water monitoring/discharged water monitoring and (b) water flow rate estimation in closed pipes. Large scale irrigation systems generally use open channels to distribute water to different areas. Trimmer describes a way to estimate the discharged water flow rate by observing the water level and pipe diameter.

Bankston provides look-up tables that map manually obtained observations to the flow rate of an open channel. Unfortunately, this method is laborious and lacks real-time response. Modern irrigation networks leverage wireless sensor network technology to monitor the water flow rate in each water channel. Additionally, they use this information to regulate the flow rate in real-time. These distributed irrigation control systems are a showcase for wireless sensors and actuators that deliver optimal water volume for agricultural irrigation. Measuring the flow rate of a liquid in a closed pipe is further divided into two categories: inline direct flow measurement and non-intrusive flow estimation. The most common example of inline flow measurement is the main water flow meter in a household that utility companies install. These meters use a mechanical turbine that spins at an angular velocity proportional to water flow rate. The constant of proportionality is the exact diameter of the flow chamber, which is estimated though factory calibration. Thus, counting the number of rotations of the turbine yields directly the flow rate in the pipe. The disadvantage of this technique is that it needs to be installed between pipes segments, requiring plumbing expertise. This is feasible during initial construction, but retrofitting pipes is tedious and expensive.

Several techniques for non-intrusive flow rate estimation exist. The most common one uses ultrasound. This technique is based on an ultrasound transmitter and receiver pair that either measures the induced doppler shift in the received signal, or the transmission time within the liquid medium. Unfortunately, commercially available devices cost over $1000 a unit and require delicate installation. Thus, they are reserved for industrial or diagnostic testing purposes. An innovative technique described by Evans exploits the vibration induced by the flow of liquid in pipes. This technique is potentially cost-effective, since it uses an accelerometer, and the data processing is trivial. However, it requires careful calibration because the vibrations depend heavily on the pipe material used and the sensor-to-pipe attachment.

2.2 Proposed Solution

The project Intelligent water distribution system, as the name says it is all about management of water supply throughout the scale, right from small societies, townships to entire urban infrastructure and also for irrigation water supply management. Main task of the water distribution system is to maintain the water in the tank and also generate the water bills to the individual households which involve human efforts. This system can be automated using the Internet of things.

3. THEORITICAL ANALYSIS

3.1 Block Diagram

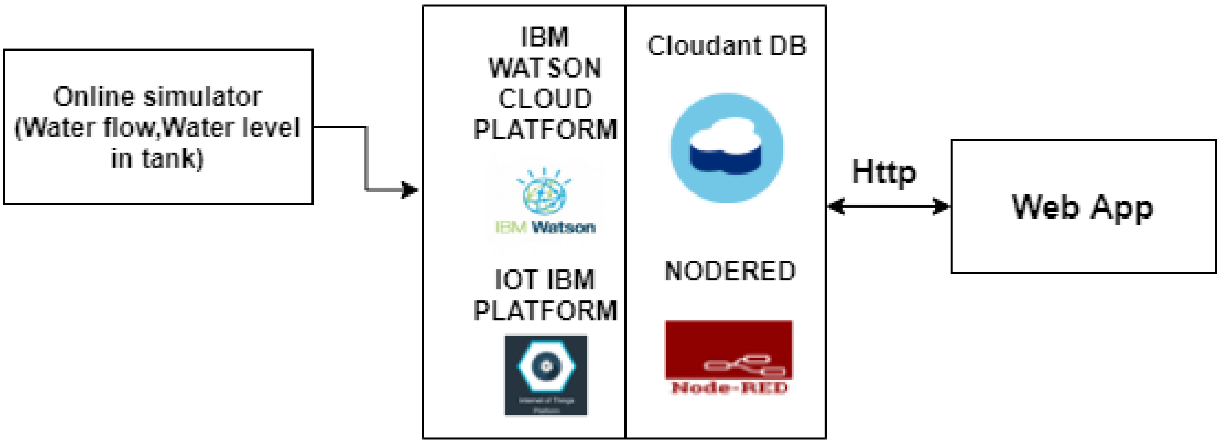


Fig 1. Block Diagram of the Proposed Method

Figure 1 shows the block diagram of the proposed method. The sensor values of water flowrate and water level in the tank were generated using online simulators. Those values are then received by the Node red and then the values are stored in online database named Cloudant DB. Then the sensor values and calculated bill amount are displayed in the web based UI.

3.2 Hardware / Software designing

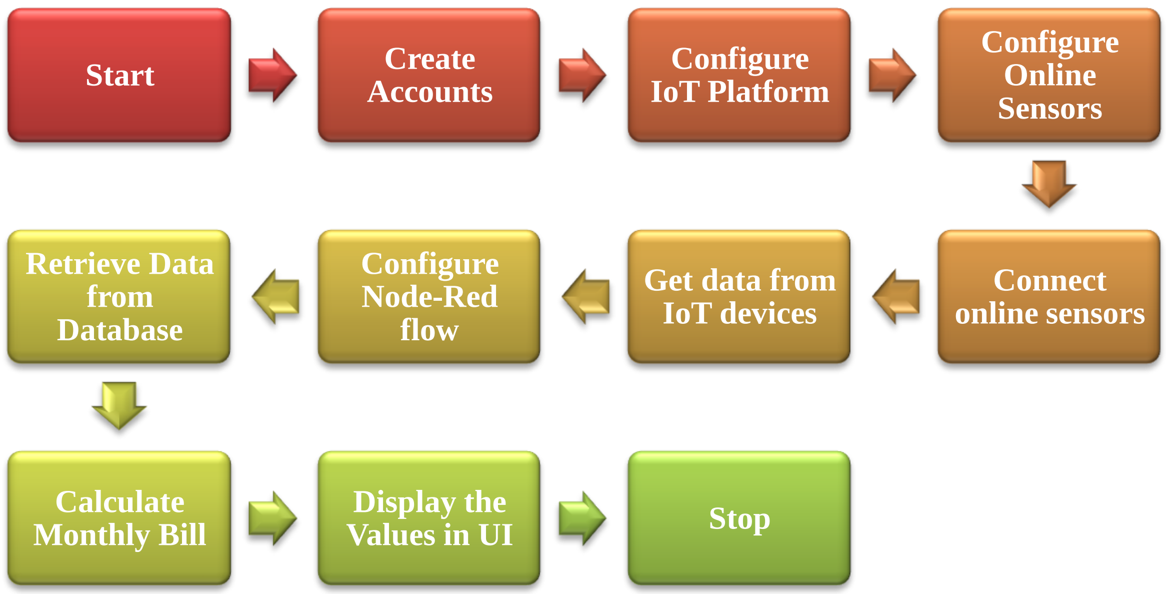
- Online Sensor Simulator
- IBM Watson Cloud Platform
- IoT IBM Platform
- Node-Red Platform
- Cloudant Database
- Node-Red Dashboard based User Interface

4. EXPERIMENTAL INVESTIGATIONS

- Created IBM academic Initiative account
- Created Node-Red Instance account
- Created IBM Watson IoT Platform

- Configured IoT Platform with Device type as Project and Device name as 1234
- Configured and connected the online sensor simulators as variables such as Month, Waterflow and Water level.
- Node-Red instance is used to get data from the IBM IoT devices.
- Configured Node-Red to retrieve the monthly flowrate and calculated the monthly bill.
- Finally, Dashboard node is used for creating UI to display the sensor values and bill amount.

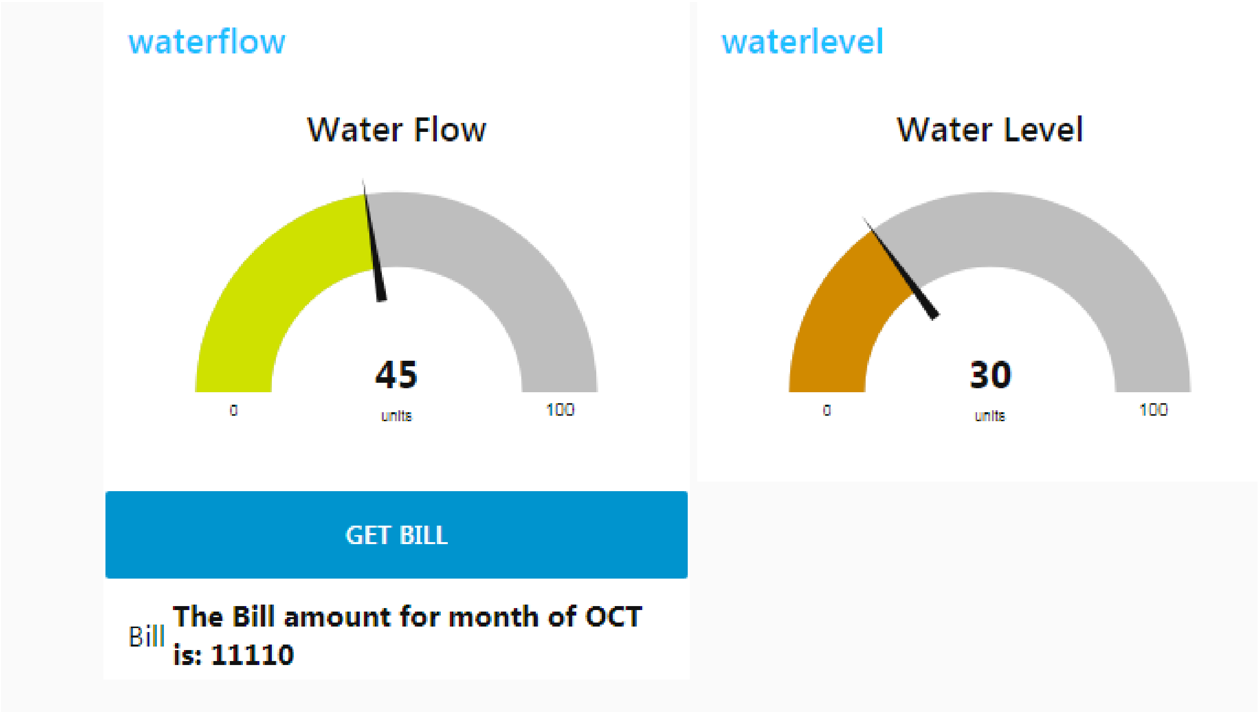
5. FLOWCHART



6. RESULT

The procedures are followed one by one and displayed the following values in the UI.

- Water flow rate
- Water Level
- Monthly bill



7. ADVANTAGES AND DISADVANTAGES

The advantages of this project are

- No manual efforts are needed
- Fully automatic
- Easy to design and install
- Real time applications
- Effective Monitoring
- Efficient Distribution of water
- Effortless and accurate bill calculation
- Cost Effective
- Less power consumption

There are no such disadvantages in this system. If so, it is negligible.

8. APPLICATIONS

The project can be applied for

- Agriculture
- Hotels
- Restaurants
- Institutions like Schools, Colleges
- Parks

9. CONCLUSION

The water monitoring and distribution system is successfully designed and verified using IBM support online softwares. Using IBM IoT platform and Node-Red, it is very convenient to design the project and Cloudant DB is very useful to store and retrieve the data from it. The process of displaying the values in UI is also very simple and shows the values in real time.

10. FUTURE SCOPE

- To implement the same with hardware.
- To program with Raspberry Pi.
- To extend the same to cover more number of buildings.

11. BIBLOGRAPHY

[1]Joy Shah. An Internet of Things Based Model for Water Distribution with Quality Monitoring”, Vol. 6, Issue 3, March 2017 in International Journal of Innovative Research in Science, Engineering and Technology.

[2]M.JayaLakshmi,”An enhanced underground pipeline water leakage monitoring and detection system using wireless sensor network”, IEEE Feb. 25, 2015, Coimbatore, INDIA.

[3]Perumal “Internet of Things (IoT) Enabled Water”, Monitoring System2015 IEEE 4th Global Conference on Consumer Electronics (GCCE).

[4]GoibWiranto, Grace A Mambu, Hiskia, I DewaPutuHermida, SlametWidodo, “Design of Online Data Measurement and Automatic Sampling System for Continuous Water Quality Monitoring,” Proceedings of 2015 IEEE International Conference on Mechatronics and Automation, Aug. 2-5, Beijing, China, Aug., 2015, pp. 2331-2335.

[5]A.Muhammetoglu, Investigation of the Renewable Energy Recovery Potential for Sustainable Water Supply Systems, TUBITAK (The Scientific and Technological Research Council of Turkey) Project Proposal No: 114Y203, 2014, (in Turkish).

[6]Lingcheng Kong and Zhihua Zhang “Water Environment Monitoring System Based On ZigBee Wireless Sensor Network”, 978-1-4673-5000-6/13/$31.00 ©2013 IEEE.

[7]CWIHC 2013, Turkish Ministry of Health Regulation Concerning Water Intended for Human Consumption, vol. 28580, Public Health Instution of Turkey, Ankara, 2013.

[8]Chen Zhang, ”A Kind of Design Schema of Wireless Water Meter Reading System Based of ZIGBEE Technology”, 2010 IEEE.

[9]Peng Cheng, Xi-Li Wang, “The Design and Implementation of Remote-sensing Water Quality Monitoring System Based on SPOT-5,” Second IITA International Conference on Geoscience and Remote Sensing, 2010, pp. 6- 10.

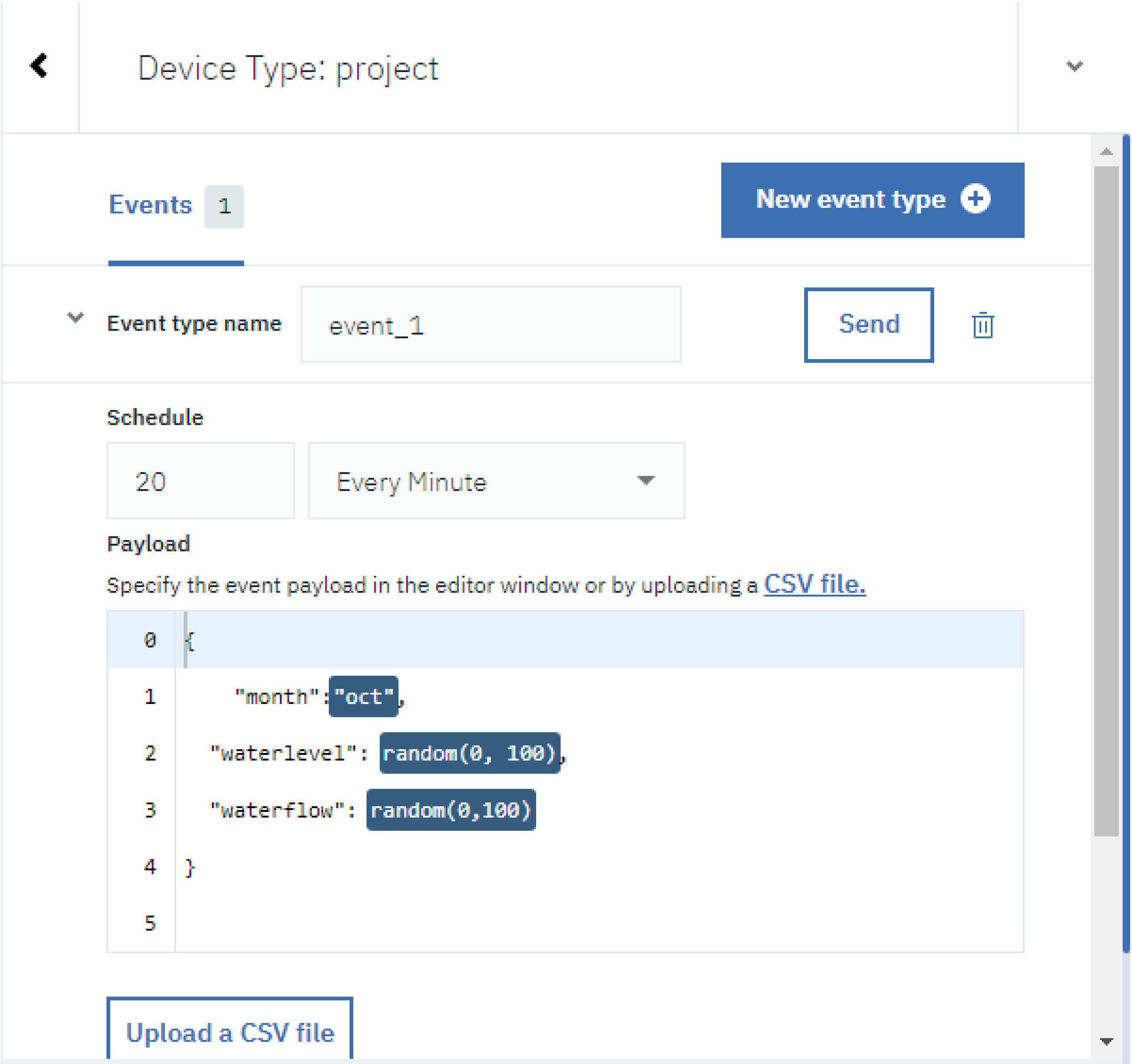
[10] E. Çelik, H. Muhammetoglu, Improving public perception of tap water in Antalya City—Turkey, J. Water Supply Res. Technol.-Aqua 57(2) (2008) 109–113

[11] EPA, Research Report: Technologies and Techniques for Early Warning Systems to Monitor and Evaluate Drinking Water Quality: A State-of-the-Art Review,

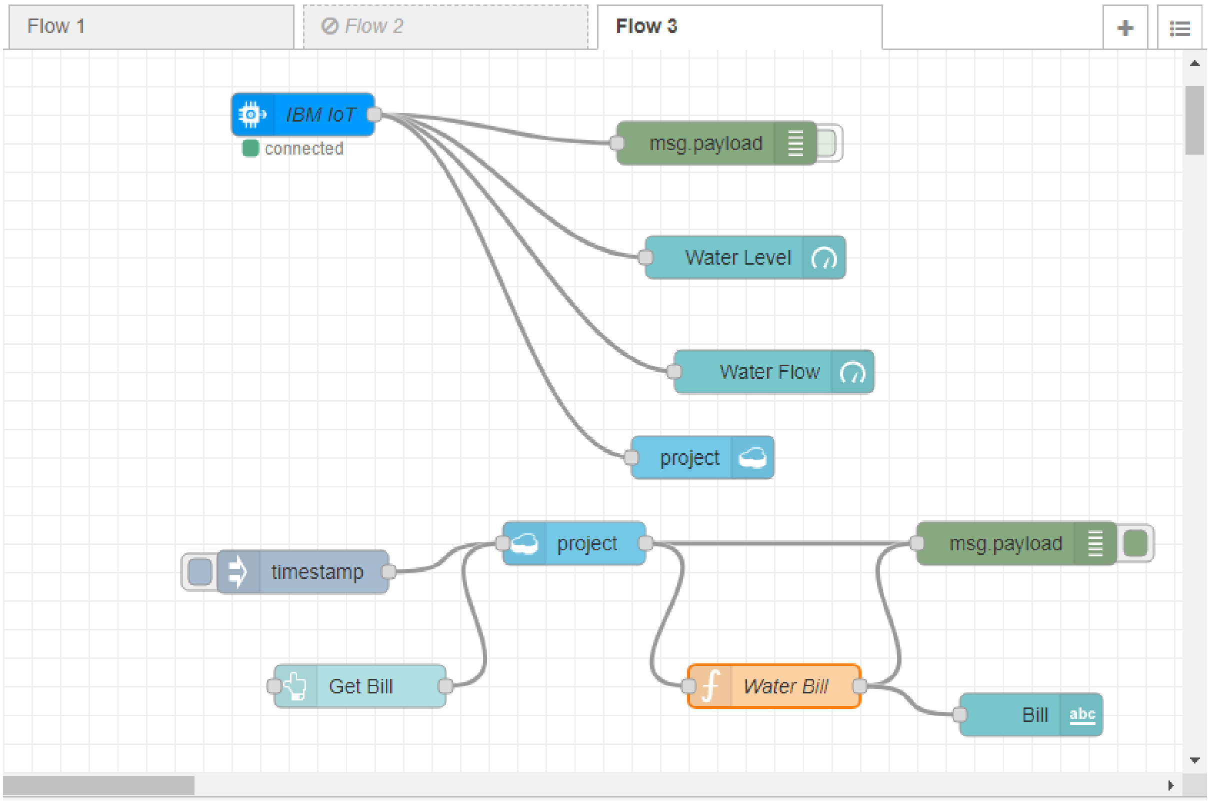
EPA/600/R05/156, Office of Science and Technology, National Homeland Security Research Center, Pennsylvania, 2005.

APPENDIX

IBM Watson IOT Platform Events code:



NODE RED FLOW:



FUNCTION NODE CODING: