Water Leakage Detection with Purity Checker for Smart Cities

Submitted By

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A Project Report Submitted to U.V. Patel in Partial Fulfillment of the Requirements for the Degree of Bachelor of Engineering in [Computer Science and Engineering with specialization in Cloud Based Application]

July,2018

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CERTIFICATE

This is to certify that the project work embodied in this report entitled "**Water Leakage Detection with Purity Checker for Smart Cities**" was carried out by Mr. Krunal Patel, Mr. Ketul Patel, Mr. Varun Parekh and Mr. Pathik Patel at U.V. Patel college of Engineering, Ganpat University for partial fulfillment of B.Tech. degree to be awarded by Ganpat University. This project work has been carried out under my supervision and is to the satisfaction of department. The students work has been published/accepted for publication.

Date:

Place:

Internal Guide   **HOD**

Prof. Parth Parekh   DR. Hemal Shah
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Prof. Hirav Shah

Signature and Name of Principal

Seal of Institute

ORIGINALITY PAGE

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Date: **Student Name**

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ABSTRACT

Water is Life. One cannot imagine life without water. But like every other substance in this universe excess amount of water has capacity to be destructive in nature. Water management has become a huge problem in under developed or developing countries like India, where due to inadequate water supply management roads are clogged with water or rain water leading to wastage of drinkable water. One such problem in water management is that workers do not know where the water is leaked until it's too late and the disaster has already struck. The water is the most valuable because it is a basic need of all humans, in these days water supply department are facing problem be-cause of less amount of water due to less rainfall, lowering of ground water in spite of all these problems water leakage from pipelines while supplying and also no monitoring of water distribution and controlling. The system purpose in this paper aims to detect the leakage in water pipeline and to check whether the water is pure or not. The idea of the project is that the leakage can be identified at the early most stage and also easily. The proposed solution monitors the flow of water through the pipes using water flow sensors with the help of flow meters and Arduino and check the purity of water with PH sensor and accordingly it will send SMS and E-mail. Also with web application, we can check how many litres of water have flown through this so it can be also used as a water meter.

Keywords: Water flow sensors, flow meters, Arduino, PH sensor

1. Introduction

A water distribution system should supply necessary amount of potable water at demand points, for domestic, commercial, industrial, and firefighting purposes; the system should be capable of meeting the demands almost any time at required pressures. However, sometimes considerable water leakages from the system may cause problems related to the pressures at the consumers tap and significant water losses. Leakages might occur from the main feeder, distribution pipes, service pipes, or storage tank; the sizes of the leakages might change from small cracks to large breaks. Less leakage means less utilization of precious water resources and we can then offer a more stable water supply service. It also prevents excess amounts of water to be discharged into the water supply network, resulting in cost reductions. Furthermore, it also contributes to energy conservation and natural resource conservation thus the reduction of environmental load. In India more than 30% of people live in urban areas that are expected to double in population by 2050. With an increasing economy and dynamical lifestyle, the pressure on water resources used for supply purpose is increasing. Most cities in India are with lack of water, with no city having 24/7 water supply. Water is very important for human and animal life for maintain ecological balance and for economic and development activities of all kinds.

In this project we have explained about water leakage detection and monitoring. This project is exhibiting a variable minimal effort device which is equipped for deciding conceivable spillages in the client's property and announcing current household water consumption levels in real time. Flow meter sensors are used to measure the quantity of water send from one end and from another end again we will measure quantity of water flow which can detect the leakage by comparison of both values. The complete information will be send thru SMS and E-mail, also the PH sensor are there to check the purity of the water. This system has been efficiently and precisely intended to limit commercial losses. And as it will be can calculate the amount of water flown from it, it can also be used as a water meter. As with the help of web app we can analyse and check that.

1.1.1 Purpose:

The basic aim of this system is to help professionals identify problems in their drainage or water supply. Web based application will enable users to monitor and control the system from all around the world without bring physically present at the time of incident. Our system also aims to reduce the manpower used behind such maintenance projects so that it can diverted it to geographically scattered places who need it more than us.

1.1.2 Challenges:

- Main challenge in a multi-faceted system like ours is effectively syncing internal and external components in such a way that the system can be fault tolerant enough to withstand real world usage.
- Another challenge to sustainable system in developing countries has to do with the inability of local government to prove appropriate services.
- Lack of adequate skilled personnel for maintenance of the system.

2. Existing Systems

Water leakage detection monitoring system using IOT

2.1 Technical Specifications**:**

    i. Following components are used in this system:
- Arduino Uno
- Flow Sensors
- Liquid Crystal Display (LCD)
- Wi-Fi Module (ESP8266)
- GSM

2.2 Working:

- The main objective of this project is to design a system which can detect the leakage of pipeline while the supply of water and if any leakage is present in the pipe then automatically the motor will turn off and the supply stops for that pipe not to have more wastage of water and to manage the flow of water which are supplied so that all can get equal amount of water by using this system. [1]

- At first the motor will on after power is supplied the water flow through pipelines from inflow of the pipeline and the water go out through the outflow of the pipeline. Then in LCD the inflow and outflow rate of water is displayed there will not be much difference. If any leakage is between the pipeline, then the inflow and outflow have more value variation by that we can know that leakage is detected and that will be displayed in LCD. After the leakage is detected then by using GSM can get the message to mobiles and the motor will be accordingly off so that the water does not flow through pipeline. The display of project board with all the connections made and interface with Arduino board is done. [1]

- The flow of water in pipeline from inflow to outflow according to the arrangement of the sensor. The LCD display of inflow and outflow of water with unit L/H. Here we are having a little variation due to having improper arrangement to pipeline. To show weather leakage is detected or not in pipeline we have arranged an area for leakage. When leakage is on the water leakage will be detected and motor off so that there will not be any flow of water. As the water leakage is done in the LCD it shows that water leakage is detected. [1]

- The programming language used in this project is embedded C. It is general purpose programming language we are using for Arduino for programming. The main steps involved in software implementation of Arduino are: Verify, Upload, New, Open, Save and Serial. Additional commands are also found in the software within the menus: File, Edit, Sketch, Tools and Help. [1]

2.2   Limitations:

- At intersections where pipes branch out into two or more than two pipelines water sensor does not provide accurate readings.
- Existing system does not have any sensors to check the purity level of water.
- An LCD display is used to display incoming data from the water sensors which is counterproductive as it increases the cost of overall system and the system already sends Email and SMS notifications.
- If a miniscule hole or crack is present in a pipeline, the leakage is not detected immediately as very small amount water escapes from such a small hole.
- The system cannot detect particular spot where leakage occurred, only it's approximate position between two sensors which in turn results to spent manpower to find the leakage spot.

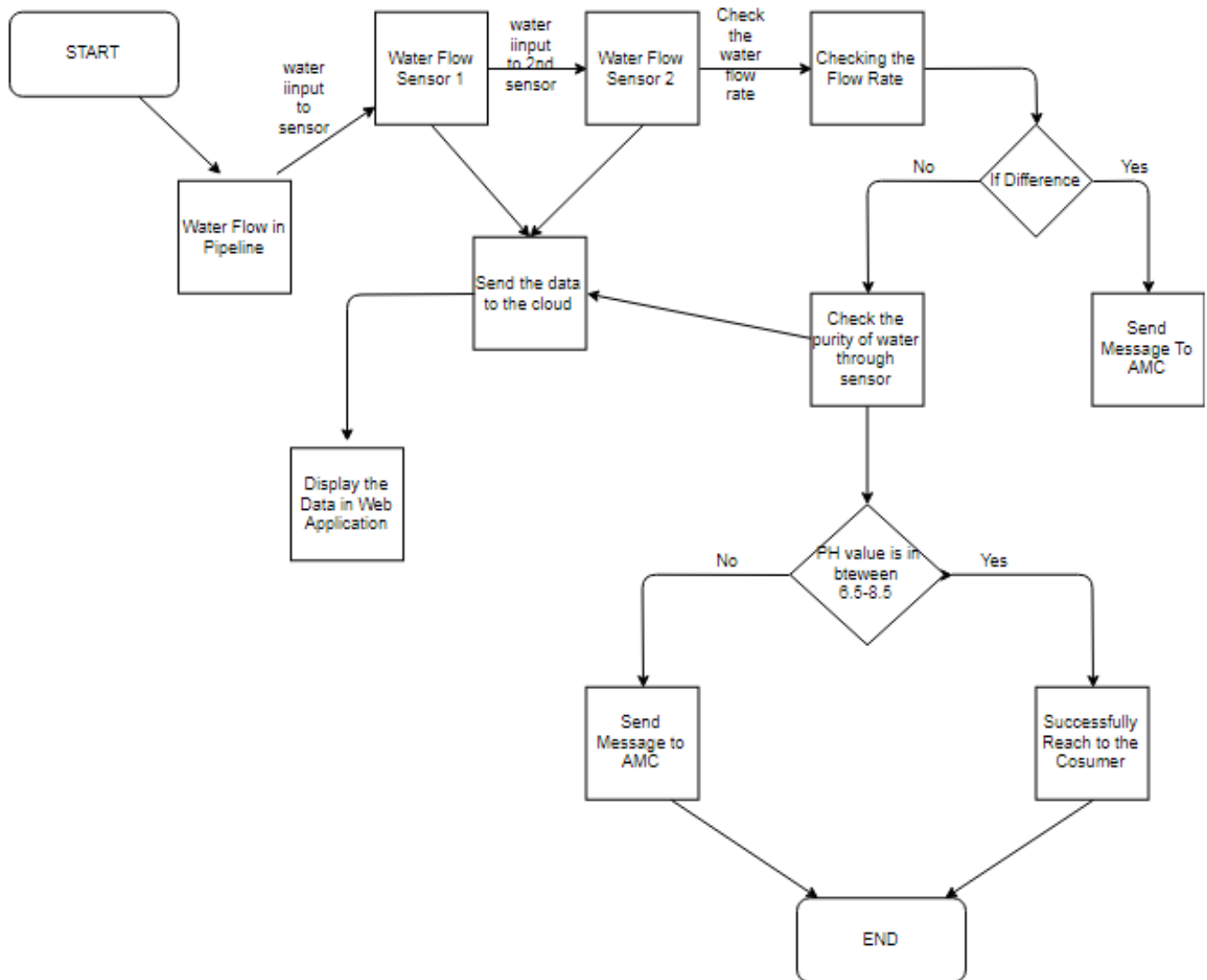# 3.   Proposed System

3.1   Architecture Model

Figure 1 Process Flow for Proposed System

3.2 Working:

- **Working of Water Flow Leakage Detection:**
  In our system water flow sensor are connected at a particular distance with the attachment of water pipe. And the water PH sensor is kept at the end of pipeline to check the purity of water coming out of the pipe. And both of the sensor are connected to the Arduino. One ESP8266 module is attached to the Arduino for getting the connectivity of the Wi-Fi so we can send the data to the cloud. And one GSM module for sending a message to the AMC or a person who handling the water pipeline system. Each sensor has its known identification number so the data are compared accordingly for leakage detection in pipeline. So with the help of the id we can find the particular area where the people of AMC have to work for solving the problem. Also, it has the record of the amount of water flown from the pipe so if we want to use it was water meter it can be used.

- Initialization & Entry Point
  From the water flow sensor, we can get to know that there is leakage or not in the pipeline. We can measure the flow rate of water at which rate it is passing to the first sensor and calculate the rate at which the water pass from the second sensor if the water level is low from sensor one to second then there must be some hole or crack between the pipes from one senor to another. If the rate of water at the exit of first sensor and the entry of second sensor is same then there is no problem but if the exit rate of second sensor is different or low then there must be problem with the water level sensor. And buy using ESP8266 module which is attached to the Arduino for getting the connectivity to the internet so it can transfer the flow rate of each sensor and the water amount flown from each sensor to the cloud for safety measure so if we want the past data we can easily retrieve from the cloud database and do analysing also with the data of water flown from each sensor we can check usage of water.

- Leakage Detection System Using Water PH Sensor:
  As in our system we have purposed a water PH sensor which check that the purity of sensor so buys this sensor we can also detect the leakage in the pipeline. If there are hole or cack in the pipeline than obviously the water gets polluted by soil or other particles so at last, we have kept the sensor which check the water PH level by default the PH level of water is in range of 6.5 to 8.5. So if the soil gets into the contact of water then the PH value decreases because soil contain the acidic particles. As soon as the water PH value goes down between in range of 5.5 to 7.0 the it detects the leakage and send a message using GSM module to the AMC or a person who handling the water pipeline. In this also the system continuously sends the data to the cloud and store the data in the databases with the connectivity of ESP8266 module which provide the internet to the system to send the data.

- GSM Module:
  When the leakage in the pipeline come into the system the GSM play important a role. The water flow sensor and the PH sensor continuously send the data to the cloud but the data is also read by the code loaded in Arduino so when the leakage is detected from the flow sensor or PH sensor the Arduino. The Arduino is connected to the GSM module. GSM module has one Simcard to send the message to the people to get the information about the leakage in the pipeline. The code return in the Arduino IDE will do this stuff like sending a message through the GSM module.

- Web Application:
  Web Application is used to show the Data from the Database stored in the cloud so if anyone needs to see the data observe and analyse than we can do it from web application.

3.3   Technical Specifications
Following components are used in the system proposed in this paper:
- Arduino Uno
- Flow Sensor
- Wi-Fi Module (ESP8266)
- PG Meter
- GSM
- IBM Bluemix Cloudant + NoSQL

3.4   Components Description:
- Arduino uno: [7]

  Arduino uno could be a microcontroller board in less weight of the ATmega328P. It has fourteen advanced input/output pins (which 6can be used as Pulse Width Modulation outputs), 6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, and are set button. Arduino board contains all the supported pins needed for the microcontroller; connect it to a computer with a USB cable or connect to power supply with a AC-to-DC adapter or battery to on the board. In this project we use Arduino board for connecting all the required components and power supply is also being done using this board. The inputs and outputs should be connected properly. While connecting the board to remaining devices proper care should be taken.

Figure 2 Arduino Uno

- Flow Sensors: [8]

  The water flow sensor model used in project is YF-S201, its working range: 1-30L/Min and water pressure: <= 1.75MpS. The Arduino flow sensor works on principle of hall effect. Flow sensor is used to determine the mass flow rate of inflow and outflow of water used in the pipelines. In this we use water flow sensor it consists of a plastic valve body, a water rotor and a hall effect sensor. This flow sensor is arranged to both sides of the pipe which can measure the inflow and outflow when water flows through sensor the rotor moves. Speed of water changes with the flow of water. By using this flow sensor can measure the flow rate of water flows in pipelines. Flow sensor is interfaced with Arduino board with 3 wires of flow sensor they are 5V power supply(Vcc),Ground(Gnd), and signal/pulse line. Connect Vcc and GND of flow sensor to Vcc and Gnd of Arduino board, the pulse line of the flow sensor is connected to digital pin 2 of Arduino.

Figure 3 Water Flow Sensor

- Wi-FI Module (ESP8266): [1]

  We use ESP8266 Wi-Fi module which is of low cost. It fully consists of TCP/IP stack and microcontroller unit (MCU). It can control any electrical device by using internet from any place in the world. It is easy to use with Arduino. For any IoT application this Wi-Fi chip can be used for easy connection. ESP8266 module has 3 operational modes they are Access Purpose (AP), Station (STA), Both access purpose and station. Upload ESP8266 code to Arduino board from Tools > board > generic ESP8266 module there are three main steps Arduino setup, installing ESP8266 platform, controlling input and output.
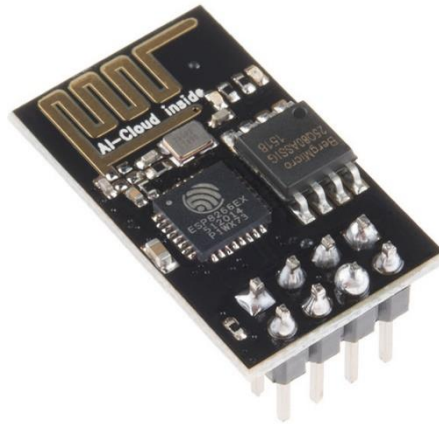
Figure 4 Wi-Fi Module - ESP8266

- Cloudant DB - IBM Bluemix: [10]
  IBM Bluemix provides NoSQL Cloudant DB which provides access to a fully managed NoSQL JSON data layer which is always on Cloudant DB services are also compatible with CouchDB, and accessible through a simple to use HTTP interface for mobile and web application models Cloudant DB is a document-oriented DataBase as a Service (DBaaS). It stores data as documents in JSON format. It's built with scalability, high availability, and durability in mind. Cloudant DB comes with a wide variety of indexing options including map-reduce, Cloudant Query, full-text indexing, and geospatial indexing. The replication capabilities make it easy to keep data in sync between database clusters, desktop PCs, and mobile devices.

Figure 5 Cloudant DB - IBM Bluemix

- PH Meter (SKU : SEN161): [9]
  An analog pH meter, specially designed for Arduino controllers and has built-in simple, convenient and practical connection and features. It has an LED which works as the Power Indicator, a BNC connector and PH2.0 sensor interface. You can just connect the pH sensor with BNC connector, and plug the PH2.0 interface into any analog input on Arduino controller to read pH value easily.

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Figure 6 PH Meter - SKU:SEN161

- GSM Module: [1]
  Global System for Mobile communication (GSM) is a computerized portable communication framework that is broadly utilized as a part of numerous of world. GSM utilizes a variety of the Time Division Multiple Access (TDMA) and is most generally utilized of three advanced remote communication innovations (TDMA,GSM and CDMA). GSM manages at either the 900 MHz or 1800 MHz frequency band. In this project GSM is used for getting messages for the registered mobile when leakage is detected. Even the motor is off if the message gets to the mobile by that the repair of the pipe can be done easily.AT commands are instructions used to control a modem. AT is abbreviation of Attention. In this project we use some of AT commands they are, AT+CMGF is to set in message format for sending to mobile. AT+CMGS is used to send SMS messages for the registered mobile number.
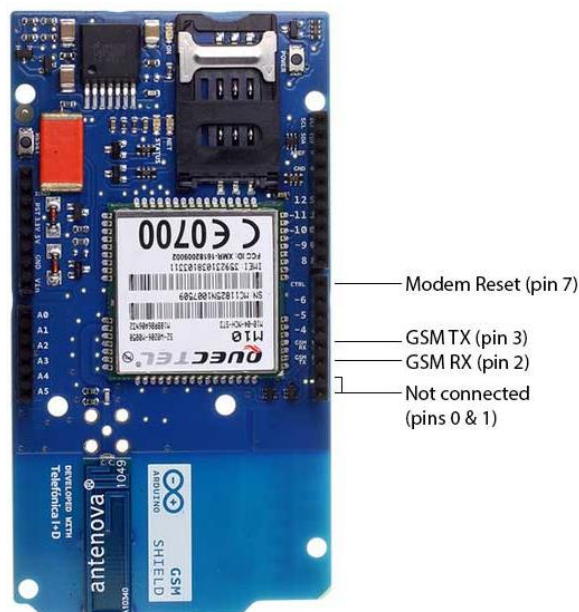

Figure 7 GSM Module

4. CONCLUSION

The system proposed in this paper aims to give a compact, efficient and accurate location of pipeline leakage. So the particular system doesn't have to roll down all the roads for one leakage they get the sensor id and the location of sensor so they can drill down that much amount of part without disturbing the public.

5. FUTURE IMPLEMENTATIONS

I future we can add Machine Learning for prediction of a hole or a crack in the pipeline that at which amount of time the hole or crack become large enough and effect the whole pipeline system so one can easily take care of it and resolve the problem as early as possible. Example of this is when the water flow from one sensor to another if the flow varies say 0.2% continuously and after some time it become 0.4% then from the data we can predict with the help of Machine Learning algorithm at which stage the hole or crack become a serious problem to the pipeline which can destroy whole pipeline and also effect the purity of water. We can also predict the requirement of water needed for the consumer with the help of machine learning

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