

# Water Leakage Alert And Quality Testing in Water Distribution Networks Using Internet of Things and Machine Learning

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**Abstract** - it is a challenging task to conserve water in this present busy world and so we use some technologies to consume less amount of water and to conserve more water. In our day today life we are not even aware of the quality of the water which we consume and also about the waters that are being wasted from leakage in taps and open taps that are left without knowing are all taken into account and these problems can be sorted by using two domains, they are internet of things and machine learning. The digital water metering system is managed by the water flow sensor. The PH sensor and the turbidity sensors are used to detect the quality of the water, the water flow can also be managed by the water flow sensor, the bills will also be generated according to their usage and if bill is not paid the water can be turned off. By using the concept of prediction analysis in machine learning the data can be analyzed and the particular day of a week or a month can be detected and notified to the user which enables the user to conserve water.

**keywords** - Water, digital water metering, leakage detection, quality, sensors (water flow sensor, PH sensor, turbidity sensor), bill generation, water flow control, data analysis.

## I. INTRODUCTION

In our day today life water plays a major role, without water it is hard to survive, and so it is one of the most important natural resources and we have to conserve it, polluting water has been done for past so many years and we are not aware of the quality of the water which we drink also and so the quality of the water should also been taken into account while considering water as the main source for the living. Wasting water leads to water scarcity, and so we are planning on using different technologies to conserve water, if we are made to measure the amount of water we are using and the amount of water we are wasting, it will be a good initiative to use and waste less amount of water. I hope by using this methodology we will be able to consume less water and conserve water more efficiently. And the main idea is to follow the quote "SAVE WATER SAVE LIFE". In order to conserve water each and every one of us should take an initiative to reduce the wastage of water in all the possible ways by the user, this project or the technique will be as a guide for the users to consume less and conserve more water and help in maintaining the nature's cycle.

## II. LITRATURE SURVEY

In this paper [1] it is analyzed on the basis of water metering system to analyze the household consumption of water and how much the water usage has been reduced are all analyzed and noted that this process helps in reducing the usage up to three to four times as compared with 200-250 liters per person, it has been analyzed for short term and long term. This process is applicable in urban areas.

In [2], a water metering system is designed with the leakage detection and location of open taps process; it also provides the user with the real time monitoring of water consumption. It also does the process of conservation of water; this system uses the open source application IEEE 802.15.4 standard embedded contikiOS lib CoAP and the wireless sensor network (WSN).

Even though we have got many traditional methods to measure the consumption of water, in [3] they have done it by using the process of image processing, they are calculated by using two cameras, each detects a needle that is attached to the container in which the water is being stored. Each time there is any change in the measure of water or if there are any image changes that are detected with respect to time are also analyzed using image samples.

In this paper [4], they have developed a wireless leakage detection system by using two main systems; they are: different sensors and the microcontroller. This system is easy to access as they are portable and has the non-destructive technique (NDT). In this system they have detected the humidity, temperature, pressure and sound detection, these are done using different sensors. They have used the arduino microcontroller.

In [5], the main application is to detect the leakage of water that is occurred in the underground pipeline system by using the wireless sensor network (WSN). They have used the process called as the wireless network system that holds the factors that are used in the process of mobile wireless sensors. They are used in the process of conserving water in the small scale only.

In this paper [6], they have detected a technique to detect the leakage of water by using the signal method. There will be some signals given by the system if there is any leakage of water in the pipe line or in the tap. They are also used only for the small scale system. By using this technique the practical implementation can be performed to conserve water and detect leakage.

**III. PROBLEM STATEMENT**

In the process of conserving water in the hose hold the bill amount should be calculated and the user should be alerted on there over consumption of water, these are not done in the [1] paper, they have just monitored the amount of water that is being consumed. In the process that is used in the [2] paper, does not does the process of automation bill generation and the water cannot be controlled by the user, this process does only detect and locate the leakage and open taps. Now a days as we are having so many technologies the author in the [3] paper has used the process of image processing, if the camera has some lens issue or if there occurs some data that are not given in the database, then the process cannot be completed and this only does the process of metering the amount of water that is being stored on to a container. In [4] process all the detection systems are done by using different sensors, whereas the processing of bills and having control over the water flow and also the quality of the water cannot be determined by the process used in this system. The wireless sensor networks are used to detect the water leakage system in the [5] and this process has the feature of mobile sensing networking system that is being portal and this can also only detect the leakage of water but cannot have control over it. In [6] paper they have used the signal method to detect the leakage of water, this process cannot be done in the real time as it requires so much of attention and those cannot be used to perform any other process. In all the papers, none of them has a sensor that is used for the analysis of water quality; the water in which we consume should be of good quality and it can be determined by using WSN, and machine learning concept is also not being applied on to the system.

**IV. ARCHITECTURE**

The architecture diagram of the process water leakage alert and water quality testing in water distribution network is given in the figure 4.2, initially there is a power supply which will enable the system to turn on or off, and when the power is turned on it provides supply to the control unit. The control unit is the master in this system, it controls and co-ordinates the entire system, it acts as the overall managing system in this process. The water flow sensor, water quality sensor, the manual monitoring display and the gateway are all connected to the control unit. The water flow sensor helps in detecting how many liters of water has been used by the user and using that sensor the water flow can be controlled, the flow of water can be turned on and off by having control on this sensor by the process of internet of things. The water quality sensor has two different sensors in it; they are: the PH sensor and the turbidity sensor. The PH sensor checks the PH value of the water by using those values the water can be determined as given in Table 4.1.

Table 4.1 (PH values)

Water type	PH values
Pure water	7
Ground water	6 – 8.5
Alkaline water	8 – 9

The turbidity sensor is used to check the sediments that may be in water tank; this plays a major role in the process of detecting the water quality. The manual monitoring system is used to detect the real time monitoring of the liters of water that has been consumed by the user, the manual monitor has a display which also indicates the bill amount for that particular amount of water. The gateway is the interconnecting portal that has the intermediate between the control unit which has all the values that are detected from each sensors and the cloud storage which has a database to store data and do two different processes; they are the documentation onto the web or the database, which is that the data are only stored on the database which has the day today usage of water, storage of data, bill are generated by using the data in the database, real time live monitoring can be done by using cloud also, the leakage on any taps or if there are open taps then they can be detected and located. When there is a leakage detected and if the user fails to turn it off, there will be an alert message sent to the user.

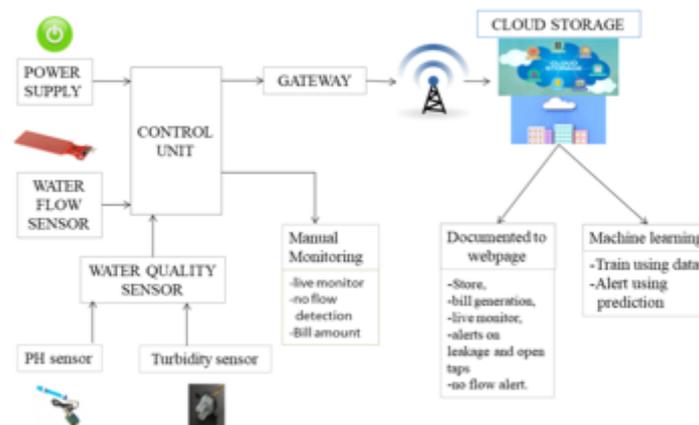


Figure 4. 1 (Architecture diagram)

The concept of machine learning is also implemented by using data in the cloud storage system. The concept of prediction analysis is used in this process, initially the data are used and the system is trained according to the requirement of the user, and the process of getting the data from the sensors for a week or a month and the prediction is made by analyzing the data, and can

be predicted on which day of a week or a month does the user consume more and on that respective day the user can be sent an alert message so as warn the user of the amount of water that they are consuming on that day will enable the users to use water with care and this will enable in conserving lot of water. This process is very user friendly and provides the cloud store that ensures that that user can monitor and control the sensors when required.

**V. ALGORITHM**

There are seven modules that are used in this process, they are: sensing, processing, gateway, web application, sms, data processing, optimization.

STEP 1: The user logs in the water conservation system with an account and a password.

STEP 2: The sensors initially sense the water flow, PH value, turbidity of the water.

STEP 2.1: According to the pulses that are generated in the water flow sensor the amount of water consumed is being calculated.

STEP 2.2: By using the values that are detected by the PH sensor is used to detect the PH values to determine the quality of the sensor.

STEP 2.3: The turbidity sensor is used to detect the sediments; they are also used in determining the water quality,

STEP 3: The process of processing is done in this step, after getting the readings the calculations are all performed. It has the microcontroller and they display the values from sensors in an LCD and send the data to gateway.

STEP 4: The gateway is a process that is used as a splitter that segregates the data and transmits it to the cloud by using the MQTT (MQ Telemetry Transport) algorithm.

STEP 5: The web applications are updated, the front end of the process is being processed.

STEP 6: The sms is a technique that is used to intimate the user of what is happening and to make them know the updates if there happens any leakage or open tap situation.

STEP 7: The data processing is a process that is used to process the data and to derive the bill amount and the amount of water consumed and the amount of water being wasted are all processed by using the derived data.

STEP 8: The optimization is a process that has two methods to optimize the data; they are: the ReLU (rectified linear activation) and the ELU (Exponential Linear Unit).

STEP 9: After the process of optimization, the data will be updated successfully.

**VI. RESULT**

The user needs to sign in to the web page and then only the user can get access to the system. The sign in screen is given in the figure 6. 1. If the user already has account then the user can also login the web page and check the process.

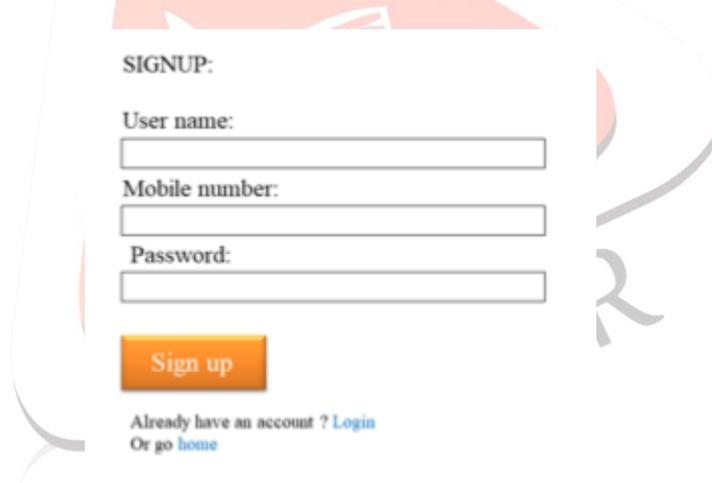


Figure 6. 1 (sign up screen)

The web page before detecting the values is given in the figure 6.2, and they provide a proper structure of the web page in which the values will be updated from the sensors and the gateway in the system.



Figure 6.2 (web page outline )

The web page with the process that has a open tap has been detected and updated onto the web page and that is given in the figure 6.3 so as to show the web page of how it works.

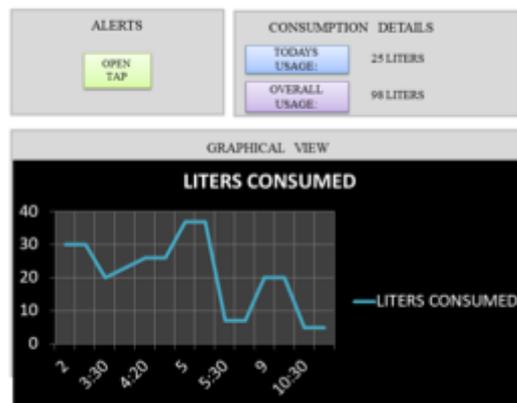


Figure 6.2 (if there occurs an issue)

The bill amount will be updated to the web page whenever the user consumes water, but every month the bill will be generated in a proper invoice format as shown in figure 6.4.

INVOICE

NAME: PERSIS  
 FLAT NO: A259  
 EMAIL: persisjain5@gmail.com  
 BILL FOR THE MONTH: October  
 PREVIOUS MONTH USAGE: 95 lit  
 CURRENT MONTH USAGE: 80 lit  
 CURRENT BILL AMOUNT: 500 rs

Figure 6.4 (bill invoice)

There is a mobile application developed to get the alerts whenever there is an alert that is to be alerted to the user, by using this application the process of alerting if there is any leakage in taps or if there are any open taps can be detected and alerted to the user by using the application and they are sent as an alert message to the user and so the user can get to know the issue as soon as possible and to make solutions for it. The process is shown in the figure 6.5 the mobile application and the alert messages.

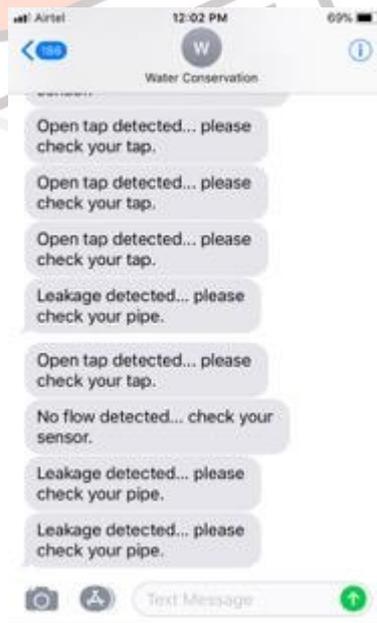


Figure 6.5 (mobile application and alert message)

The screenshots describe the entire process that is being done by the system. The user needs to login to the web page if the user is new then they need to sign up to the web page and then only the user will be permitted to access the water from the tank. The life monitoring can be done by manual process also as the readings will be detected in a LCD monitor, or if the user needs to

monitor from other place also the user can login and check the live updates on the web page. And the user will be given a mobile application using that the user can get the alert messages if there occurs any issues in the system as like any leakage or open taps detected in the system.

## VII. CONCLUSION

Thus, by using this technique we can conserve lots of water and can help India from scarcity of water, and that enables us to secure lots of fresh water for future. This technique comprises of two domain, they are: internet of things and machine learning. This also helps in preventing the usage of unwanted water usages, which helps in conserving more water. It also helps in detecting the quality of the water which we consume which makes a useful product for each and every one to drink water as water plays the major role in the human life. Now a days wasting water in houses and industries is being common, and so let us not wait for others to start conserving water, let us take a step ahead to conserve water as possible.

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