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Study on IOT Based Framework for Smart Water Supply Systems Management

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ABSTRACT :

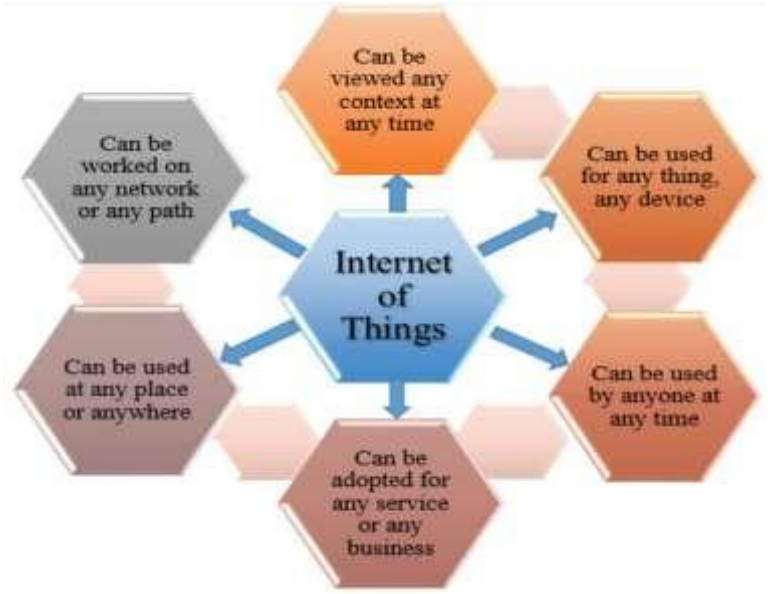
Global population growth and climate change increase the demand for high quality water. This fact compels man to devise new water management strategies. Smart cities have successfully implemented Internet of Things (IOT) technology in many areas. In addition, Complex Event Processing (CEP) can analyze and process large data sets developed by IOT sensors. Traditional business processes are very strict in expressing the dynamic behavior of the water supply system. Every path of implementation must be clearly defined. On the other hand, declarations allow business execution routes that are not prohibited by regulations, which provide greater flexibility for water supply regulators. This paper combines IOT, CEP, and the declaration process to create a powerful, efficient and flexible Reflex Water architecture to manage the water supply system. To the knowledge of the authors, Reflex Water is the first solution to integrate these technologies in the context of water supply systems. The dissertation explains the Reflex water architecture and its application for real water systems from the Brazilian municipality. The results are promising, and Brazilian water company managers are increasing the use of reflex water in other areas of their water supply systems.

Introduction:

Leakages in portable water supply lines causes revenue loss and impacts the economies. Globally the water loss figure due to leakage is pecked to a staggering 40% and costs up to ~US$ 100 billion in revenue. So, there is a pressing need to develop systems to monitor pipeline leakages to avoid the water loss. Water leakages in pipelines caused by structural defects such as cracks and these can be determined by various methods including acoustics. When water leaks through cracks at higher velocity it creates a hissing noise due to friction. Frequency signature of the hissing noise for smaller cracks are much higher than the larger crack. This enables the viability of acoustic sensors such as hydrophone to pick up these acoustic signatures as a means of leak detection.

This work presents a hydrophone based wireless sensor node and a platform that is designed for the purposes of water pipe line leak detection. The leak detection method is to place active hydrophones (with a built in pre amplifier) at regular intervals on the pipelines to pick up acoustic signature. When a crack on the pipe occurs, leak through the crack generates an acoustic noise that is easily picked up and amplified by the active hydrophones. This then conditioned and sampled to generate digital samples.

The extreme applications of Internet of things in day today real life can make the human life smart, safe and simple. IOT is having various applications in field of health care, agriculture, transportation, waste management, environment, buildings, bridges etc. Implementation of IOT in all these application zones reduces the human effort as well as increases the quality of life (Sethi, 2017). Figure 2 shows some of the important applications of IOT. This paper explains the real time water leakage monitoring system, which is one of the main applications of IOT. Various methods are available to detect and locate the water leaks in pipes, by connecting water monitoring system with IOT. Pressure measurements, flow measurements, vision based systems, acoustic measurements, fiber optic monitoring, ground penetrating radar based system etc. are some of the methods which are used for pipe monitoring. This study deals with flow measurement method using flow sensors integrated with micro controller to detect and locate the water leakage in pipelines.



Review:

Global leakage on portable water supply lines exceeds 40% at a cost of ~ US $ 100 billion in revenue and has a significant economic impact. This means that there is a need to develop leaky pipeline monitoring systems to prevent water loss. The typical signature of the attractive sound made during a water leak, can be detected by acoustic sensors such as a hydrophone to detect water leaks. In this project a hydrophone based IOT wireless sensor node and a leaky pipeline detection platform was introduced. Leak detection is achieved by recording acoustic signatures from a large number of active hydrophones that are periodically placed in the pipes to take the acoustic signature. Captured acoustic signatures are sent to a central server via a Wi-Fi network for post processing and leak detection

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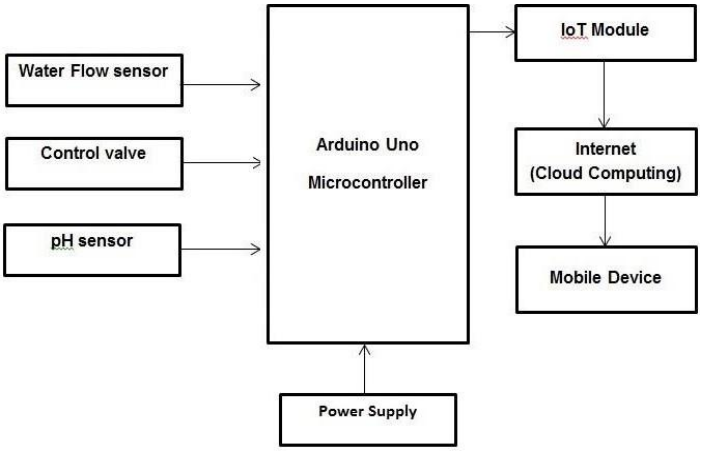
Water is one of the most important resources used in the world. Most people around the world do not have access to clean water that can be used, as only 3% of available clean water can be used. Urban migration and industrial development are the main reasons for the water shortage. Apart from urbanization and industrialization, leaks in water supply pipes are a major problem of water shortages if they are not available in the first place. Leaks can cause serious damage to building structures and also lead to significant loss of water that can be used when supplied by water pipes. In recent years, a number of studies have been conducted to improve advanced water management technology. As a result, a new automated process was introduced, the Internet of Things (IOT) that could connect virtual objects to the Internet. In this paper an attempt is made to demonstrate the use of IOT through a leak detection system and monitoring. This paper emphasis is on how the sensor system can monitor, detect and detect leaks in the plumbing system. This study also aims to develop a limited type of real-time water leak awareness system and verify it through testing. A smart sensor network system consisting of flow sensors and a collection of an active sensor network platform is used to monitor and detect pipe leaks. The flow sensors provided in the pipes collect information related to the discharge of the pipes. Data collected by sensors is processed by a microcontroller- Adriano Uno. Finally, the data used is viewed online using cloud computing.

IOT-based Water Monitoring System for Smart Buildings. Water is an important natural resource for sustaining life. Leaks and misuse of this precious resource contribute to water shortages in many parts of the world. Remote monitoring of water use and leak detection, warning users and allowing disruption of water supply can play a significant role in reducing costs and preventing the destruction of this valuable natural resource. The Internet of Things (IOT) paradigm can make a significant contribution to this goal. Subsequently, the paper proposes the development, construction, and validation of a smart system for remote monitoring of water use, leakage and disruption to water distribution. It is characterized by intelligent architecture and can easily be used in other related areas. The proposed solution follows an IOT-based approach and can be easily integrated into an intelligent IOT solution. It has been tested, demonstrated, validated, and ready for use.

Methodology:

The objective of this paper is to develop an intelligent and smart system, which can perform the real time monitoring and detection of the water leakage in the pipelines in early stages itself. Figure 3 represents the major components of the proposed water leakage system. The system mainly consists of Adriano Uno, GSM, LCD, flow sensors and power supply. Water leakage monitoring system integrated with IOT is developed to save every single drop of water, which is wasted through pipeline leakages in building. The data that is used in this study is the rate of flow from sensors which is provided at the inlet and outlet section. Two water flow sensors are used to determine the inflow and outflow rate of water. A water pump is used to supply the water through the pipeline. When the system starts to work, water is allowed toflow through the pipeline which is connected with the inflow and outflow measurement sensors.

The block diagram as Smart water distribution andmanagement system are shown below:



The Fig shows the Sensor used are water flow sensor, Solenoid valve, pH sensor. The IOT module used is Ethernet Shield and the cloud computing is MQTT. The control valve is used to control the water flow ON and OFF through the pipe from tank to the consumers. The control valve is the solenoid valve and the valve is turned ON and OFF by the Adriano microcontroller The water flow sensor is used to sense the water flow through the pipe and sends the pulse to the Adriano microcontroller. The pH sensor is used to check the quality of water, pH range and the water is supplied to the consumers through distribution. The control valve of turning ON and OFF can be controlled from the mobile or the MQTT server. The IOT platform used for controlling the devices and it is very useful for the management team or the control officers to control the whole system of waterdistribution through IOT.

Initially, water flows through the inflow sensor and go out through the outflow sensor in the pipeline. The rate of inflow and outflow is sensed by the flow sensors connected to the pipe and have a diameter which is equal to the diameter of the sensors. The data obtained from the sensors are sent to the Adriano for processing while obtained results (inflow and outflow rate) are displayed on the LCD screen. Identification of the leakage in the pipes between the two sensors can be detected through difference in the inflow and outflow rate i.e., no difference between the inflow and outflow rate indicate no leakage while difference greater than 60 L/hr indicates the leakage (Figure 6). When leakage get detected, Adriano will automatically activate the GSM to send alert messages to the registered mobile number and to the cloud system with the aid of a SIM card and external power supply.

In this study, YF- S201 is used as the water flow sensor which is having a working range of 1-30 L/min and water pressure <= 2.0 MPa. This sensor mainly consists of a rotor, plastic valve body and a hall effect sensor. When the water starts to flow through the sensors, the rotor rotates and the speed of that rotation (water) is directly proportional to the flow rate. Hall effect sensor generates pulse/signals for every rotation of rotor (Rahmat et al, 2017).The pulse generated by the hall effect sensors are send to the Adriano to analyse and display the flow rate. The flow sensors are connected by a 2 m pipe to measure the inflow and outflow through the pipe. Flow sensor consists of 3 wires; they are 5v power supply, pulse line and ground line. These are very easy to interface with Adriano, which makes the system smart. The signal line of flow sensor is connected with the digital pin 2 of Adriano where the power line and ground line of sensors are connected with the power line and groundline of Adriano. Figure 4 shows the YF-S201 flow sensor.

Conclusion:

Water is main resources and basic things for all. But, when using water, user does not know how to maintain properly. Suppose, the user does not waste any water, it leads to the possibility of safeguarding the environment. Water usage may vary based on climate change, water sources, uncontrolled water supply

that results inadequate water to users, industries with difficult economy planning and higher investment risks. Thus the proposed system has a cutting edge to the smart city environment in providing the needed water supply to each and every house. It is essential to prevent leakages in the water pipelines as the amount of consumable water is only around 3% of the total available water on the earth. Normally a large amount of water is being wasted through leakages during the transmission of water using pipelines. Thus the proposed prototype with the modern technology and equipment helps to detect and monitor the leakage in water pipelines. The main advantage of this smart sensor network system is that, it has real time monitoring system with less interruption of user as well as the leakage detection system which rectifies in the early stage so that it reduces the intensity of damage.

Thus the sensors will be controlled by the distribution team. Man power is reduced in the distribution team. The water quality is observed and maintained in this project. The leakage detection can be identified in this project and the Central office can control the whole setup using the IOT based smart water distribution and management system. The water crisis can be reduced and the future usage of water can be maintained by the management and distribution team.

Computation of science, especially fluid mechanics and kinematics physics is implemented on microcontroller. Adriano chip-based ATmega328P can be used to detect the location of leaks in pipes by using a data rate of water flow and the system is able to work stably to determining the location of the leak with a maximum distance of 2 meters and it can determine the location of the leak closest to the actual location of the leak with an average flow rate of 10 litters per minute. One plan in the future work is to extend the detection ability to more than 2 meters, which later on can be developed by considering the time duration of the reduction in water flow rate when there is a leak so the accuracy of the leakage location is improved. Another future work is to implement the detection system to branched pipelines as well as using various water flow rates.

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