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Water Leakage Detection and Monitoring System Using IOT

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ABSTRACT

The water supply shortage has increased in recent years due to overpopulation, climate change and obsolete water facilities, where deteriorated pipes cause most of the water leaks. The problem is not the size of the leak, but the time it takes to detect it. This paper presents the implementation of a system installed in the hydraulic facilities of a residence, to detect water leaks. The system consists of a water sensor installed by a water reservoir of interest, a microprocessor to interpret the data and evaluate. The design of a water level sensor device that can detect and control the level of water in a certain water tank, the system firstly senses the amount of water available in the tank by the level detector part and then adjusts the state of the water pump in accordance to the water level information. There has been wastage of water daily through the pipeline leakages due to its full water were never arrived to the taps. The aims of our proposed work are to develop a real-time prototype pipeline leakage alert system whether it is a water leak or not, an alert message send to IoT Application to avoid leakage.

Index Terms – NodeMCU, Water Flow Sensor, Buzzer, IOT.

I. INTRODUCTION

With the growth of the world population, the demand of fresh water has increased causing serious problems in the field of water supply. Therefore, control of water has become a considerable issue today. With the growth of the world population, the demand of fresh water has increased causing serious problems in the field of water supply. Therefore, control of water has become a considerable issue today. Scientists, technicians, politicians, and generally, many other inhabitants of the planet become increasingly educated on the subject. The threat of pollution hovers over and limits water supplies. The shortage of this vital liquid requires great attention. The proportion of fresh water found in rivers, lakes, and underground sources comprise only 3% of the total amount of water on earth. In addition, the water found needs treatment for human consumption, to eliminate particles and organism harmful to health, and ultimately must distribute through pipes to homes safety.

This work focuses on the issue of distribution, more specifically, on the issue of “water leaks” in

residential areas. In a developing country like India, loss of water in domestic sector on account of leakage is approximately 30 to 40% of the total flow in the distribution. This leads to high risks in public health, money invested and on the valuable natural resource. India had an irrigation efficiency of ˜36 percent in 1993-1994 and projected that efficiency would have to increase to 60 percent by 2050 to bring a balance in the demand and supply of water. Even those slow leaks that only because mold damage require expenses to repair. The more water spilled (or splashed) the more money the repairs cost to residents. For this reason, it's crucial to have some system installed in residences to detect water leaks. Current digital water leak detection systems can locate multiple water leaks to within 1-meter resolution over a complex network of cables running several kilo meters.

II. Methodology

The water leakage detection system can be deployed in the already existing plumbing with flow rate sensors attached in the path of the water flow. The sensor does not obstruct the water flow but just collects the data of flow rate. Actuators like solenoid valve is needed to control the water flow in the event of a leak.

The proposed system uses a microcontroller which constantly reads the data from multiple flow rate sensors thereby constantly monitoring the water flow. It compares the flow rate by calculating the difference in data from subsequent sensors and takes the necessary action. If the difference is greater than the Set threshold , microcontroller sends alert information to the user. This minimizes the water wastage. On the other hand, if the difference is less than the threshold, it sends the sensor data to the cloud for data logging and the process continues as shown in Fig. 1. Online data logging allows the user to keep track of the water usage and take necessary decisions to conserve the water.

The Microcontroller constantly monitors the flow rate when the system is in On State. The Leak detection algorithm works in such a way that, whenever the Flow rate difference between two consecutive sensors is greater than a calibrated threshold value, a leakage is detected by the microcontroller. Fig. 7 shows the leakage scenario in the system. The Flow rate difference is also logged into the Cloud through GPRS module as in Fig. 8. Whenever a Leakage is detected an alert or notification is triggered and message is sent to the concerned authorities.

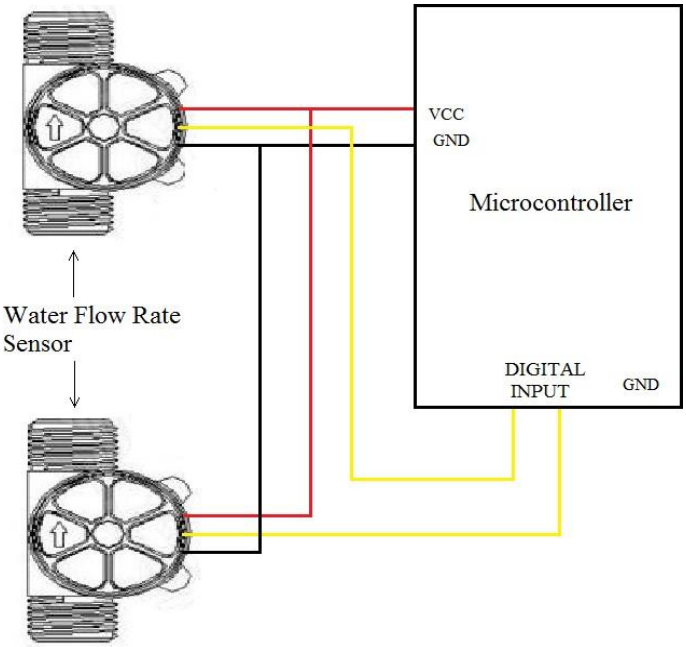


Fig 1. Microcontroller Connected to flow Sensor

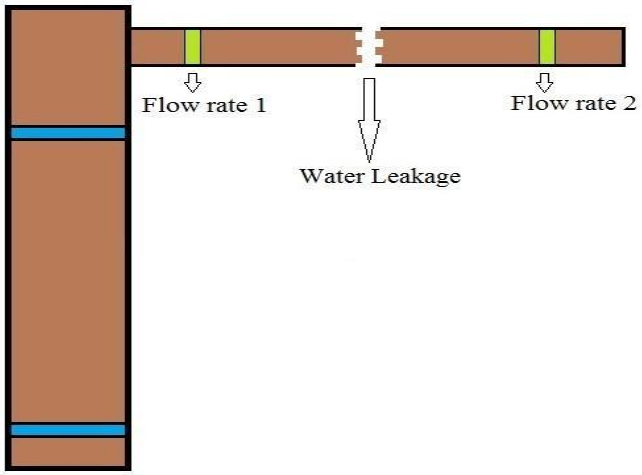
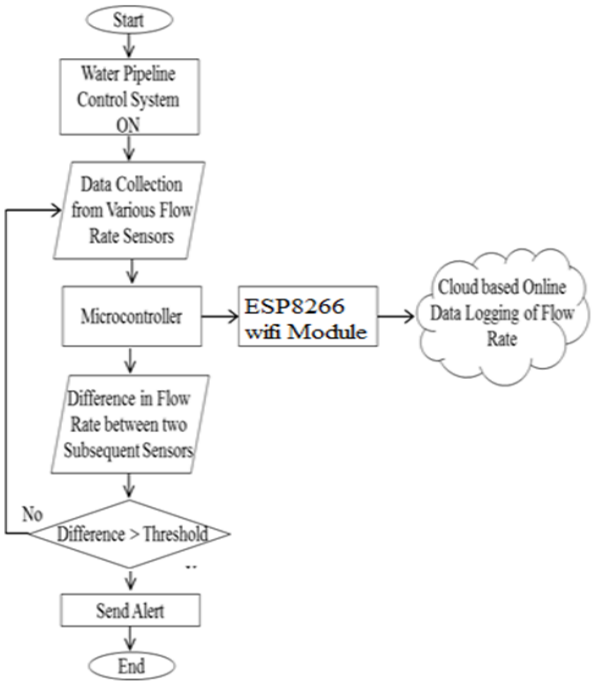


Fig. Leakage Scenario

The automatic water cut-off system is very useful to stop the leakage of water at various points if a leakage is detected. The Monitoring system detects the leakage of water and sends an alert signal.

All the flow rate measurement sensors pertaining to a particular area are connected to microcontroller for as show in Fig. 6. Couple of microcontrollers is connected to the Network such that we can monitor and control water supply for the whole region. Each Flow rate sensor sends the amount of water passing through it to microcontroller. The microcontroller collects the data from flow sensors and sends the values to the Cloud using GPRS [7] connected to the internet. The flow rate measurements are logged into a sensor cloud which can be utilized for later use. This method is commonly known as data logging.



Hardware Component

1. NodeMCU Microcontroller

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the dev kits. NodeMCU board as shown in fig 1. The firmware uses the Lua scripting language. It is based on the eLua project and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson, and spiffs.

NodeMCU is an open-source Lua based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

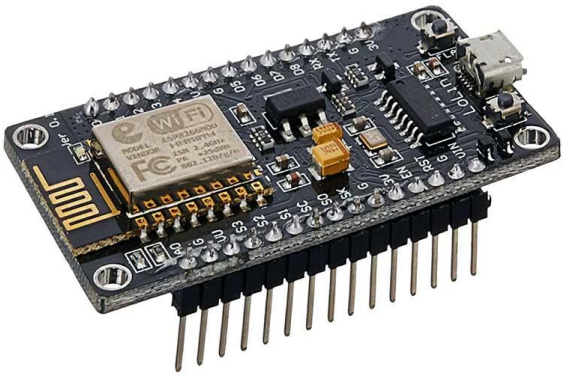


Fig1. NodeMCU Controller

2. Water Flow Rate Sensor

Water flow sensor consists of a copper body, a water rotor, and a **hall-effect sensor**. When water flows through the rotor, rotor rolls, its speed changes with different rate of flow. ... This one is suitable to detect flow in water dispenser or coffee machine.

Water flow sensor consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow.The hall-effect

sensor outputs the corresponding pulse Signal.The water flow sensor as shown in fig 2.

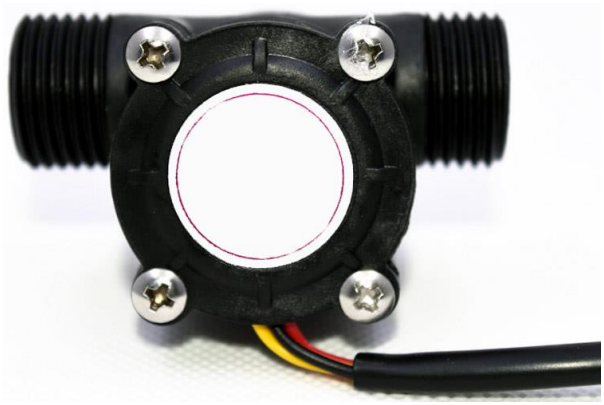


Fig 2. Water Flow Rate Sensor

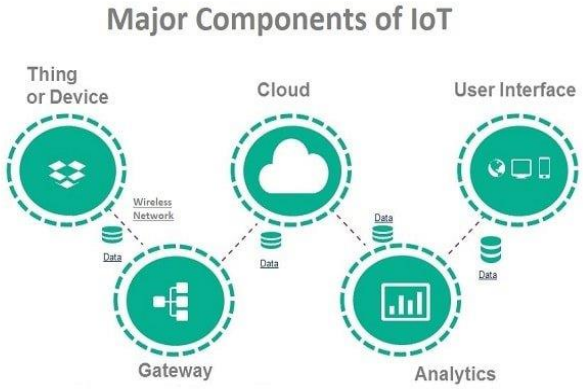
3. Buzzer

A buzzer or *beeper* is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of *buzzers* shown in fig 3 and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

4. Internet of Things

The Internet of Things (IoT) describes the network of physical objects "things" that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments.



III. RESULTS AND DISCUSSION

A prototype was developed with help of three flow rate sensors in series in the water pipeline. The prototype is tested at various conditions of water flow. Positive results were obtained using the prototype built.

Water Flow controller is turned ON initially such that water flows through the water pipelines. The Flow rate data of both the sensors is obtained by the microcontroller periodically. The Microcontroller also uses water leakage detection algorithm to calculate the flow rate difference between three consecutive sensors. The difference is also logged into the Cloud for triggering the leakage detection. Once the leak is detected notification is sent to authorities for fixing of damaged pipelines. In addition to Water flow is stopped when leak is detected.

IV. CONCLUSION

Water for domestic purposes is always very essential and it is mandatory to prevent it from getting wasted due to any pipeline leaks. Hence the designed prototype is an effective solution for monitoring the flow of water as well as detecting for leaks in the pipelines. The smart water leakage detection system can help in water distribution process by remote activation of solenoid valves. Usage of cloud logging technique enables the data acquisition and analysis in any point of the pipeline. This makes the system cost efficient and simple.

The system is capable of detecting leaks between any sensor nodes rather than the exact location of the leak. The sensors require lengthy wiring for power supply and data transmission. This reduces the area under observation. The sensors and actuators can be powered by batteries or solar panel. Wireless transceivers can be fitted to acquire the data from the sensor and send command signals to actuator. This sensor network based system may increase the system cost, but it adds the advantage of monitoring a huge area with minimal human power.

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