RESEARCH REVIEW JOURNALS
Volume-04
Issue-03
March-2019

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com[UGC Listed Journal]

IOT Based Smart Water Distribution and Leakage Detection System Using WSN

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ARTICLE DETAILS

Article History
Published Online: 13 March2019

Keywords
Water distribution; Water resource management; Leakage Detection ; ARM; Sensors; IOT; WSN; Web Page.

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ABSTRACT

Water is the lifeline for nature and all living beings. It is the most valuable and scarce resource and hence systematic management of this resource is vital for social and economic development of any country. Wastage of water is the major concern across the country, and the main reason behind this is improper supply of water system and poor management. From past decades, needs of water have increased unpredictably in India. Along with increasing population, demand of water supply is also increasing and has become a major challenge for world. Climatic changes, urbanization, and wastage has further depleted the resource. Importance should be given to conservation, consumption and management of this valuable resource. The idea of connecting everything by wireless technology sums up IOT. In this project, system presents an IOT based design for water monitoring and control approach which supports internet based data collection on real time bases. The system addresses new challenges in the water sector flow rate measuring and the need for study of the supply of water in order to manage water wastage and encourage its conservation. The proposed system monitors the water in the reservoir by using ultrasonic sensor and measures the flow of water as well as the quantity of water being distributed with the help of flow sensor. Along with it, the system also measure the quality of water distributed to every household by deploying pH and conductivity sensors. The traditional water metering systems require periodic human intervention for maintenance making it inconvenient and often least effective. This project is an innovative step to digitalize the water supply system, throughout the cities as well as villages. A step which sets a platform to improve the water supply system, and helps everyone to “Save Water”.

1. Introduction

1.1 Overview of the System

In some water-related field such as pre-flood warning system, irrigation system, electricity powerhouse, and research, water level information is a very important issue. Usually, water level measurement was done manually, however this can be not effective due to some difficulties like problem to reach the measurement site, human error, etc. Some automatic water level measurement systems have been made using mechanical sensors such as resistive sensor, capacitive sensor, or magnetic sensor, but these sensors have to do direct contact with water that makes their life span shorter because of corrosion. On the other hand, this system uses ultrasonic sensor that can measure the water level without direct contact with water, which makes its life span longer.

Now a day’s different types of smart sensors are developing for the safety and security in emergency management strategy. Smart water management is only possible with help of IOT which includes the applications in monitoring the flow of water, Management of valves, fault detection within valves, Data analysis through Observations from different meters etc. in conventional method for each and every individual processes we require the human power and observation skills. To overcome these IOT plays the major role.

1.2 Problem Statement

The current scenario is, the employee goes to the location and opens the valve for a particular duration, and then again the employee has to go, to close the valve. This is time consuming. There is no proper database of distribution and management of the resource. A smart water distribution system using IOT is going to be beneficial for real time database collection. This system will implement the design of IOT based water distribution and monitoring system that monitors the quality of water, flow-rate and level of water in real time. This system consists of some sensors which measure the all these water parameter and the primary concept of real-time IOT based water resources information system is to provide comprehensive and accurate information.

1.3 Objectives

The main objective is to design a smart water distribution and leakage detection system using wireless sensor network and IOT platform. It is also used to identify and minimize water losses. This project promote sustainable development, provide fair way to allocate costs, improve system energy efficiency and improve customer service level. The system helps in implementing best management practices.

2. Block Diagram

The system enlisted in the paper consists of Controller ATMEGA328P, Ultrasonic Water level sensor, pH sensor, Conductivity sensor, Flow sensor, nRF24L01 Transceiver, ESP8266Wi-Fi module, Power supply,IOT plat-form,Web Page.

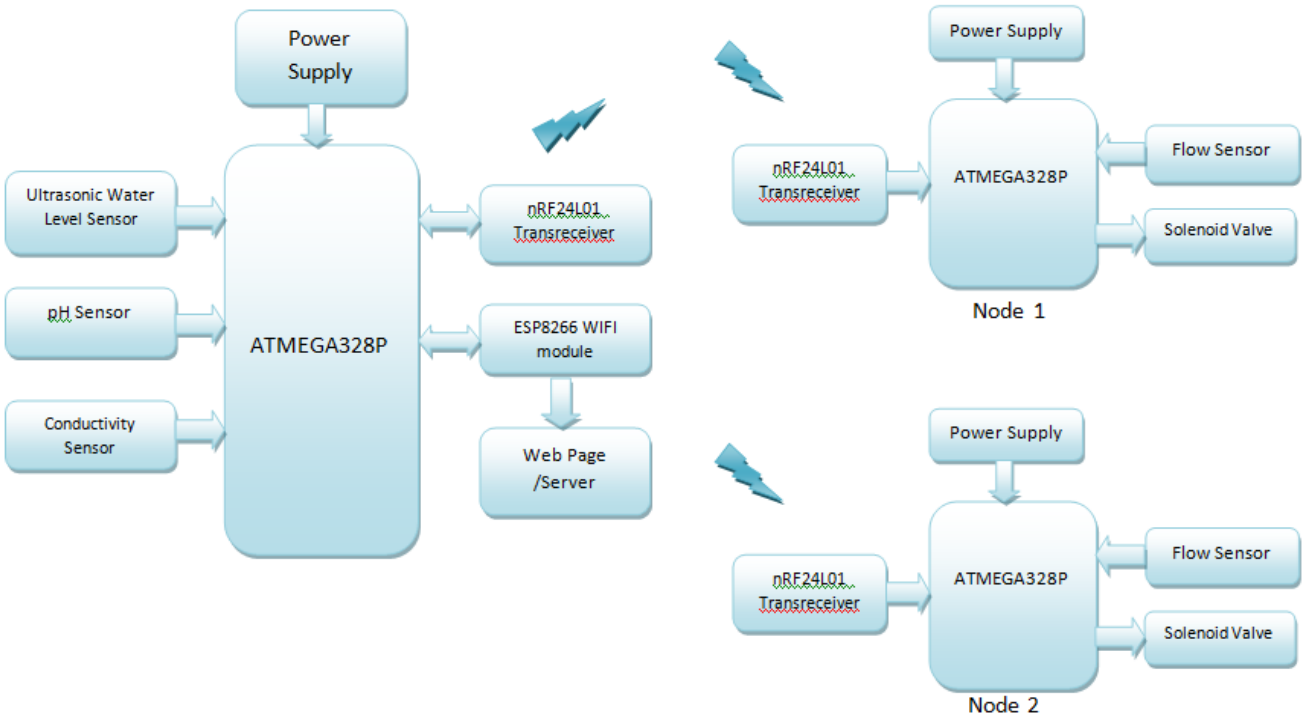

Fig1. Block Diagram

The working of the proposed system is explained as below.

In this system, controller ATMEGA328P and different sensors are used along with Internet of Things concept. Firstly, all sensors which are interfaced with controller will sense the parameters related to water such water level using Ultra-sonic sensor, flow rate using Flow-rate sensor, quality of water using Conductivity and pH meter and also detects the leakage during distribution using Flow sensor.

Reservoir side module calculates water present in it and sends data regarding water level present in reservoirs to central office on daily basis. This module contains ultrasonic sensor to sense the water level and communicates with controller to process operation such as calculation of water present in reservoir and volume data is send to central office using IOT.

The rate of flow of water during the distribution period is sensed by the flow rate sensor and the sensed data is send by the controller to the web page. Along with the water level and flow rate the quality of the water and conductivity is also tested using pH meter and conductivity sensor.

All these sensed parameters are further given to the control-ler ATMEGA328P for processing. The controller will receive this data and send it to the internet through serial communication. Inter of Things is the advanced concept which we are going to use for this system. Basically, a web page will be created where the data will be monitored and managed from the server room.

3. Operation of Proposed System

In the proposed system we are using AVR AtMEGA328P, ESP8266 Wi-Fi module, nRF24L01, pH sensor, Conductivity sensor, Ultrasonic sensor and Solenoid vales. The system is based on IOT platform with wireless sensor networks, so we willhave the benefits of IOT as well as wireless sensor net-work. For IOT platform we are using ESP8266 Wi-Fi Module, which works at 2.4 GHz Frequency with 1Mbps data transfer rate which is used to upload the sensors data such as temperature, pH, waterlevel and flow rate, amount of water in and out from the branch as well as status of solenoid valves. With the analysis of water flow in a particular branch we can detect the leakage in the pipeline and can cut-off the water supply in the branch with the help of solenoid valves.

WSN system consists of wireless sensor nodes that sends the sensed data to the main node for that we are using nRF24L01 wireless transceiver each nRF24L01 module can communicate with 5 nRF24L01 modules at the same time we are using another of AtMEGA328P to create the nodes and control the solenoid valves and send the flow rate at each branch. All this data from the sensors of main node, flow rates from each and solenoid valves are uploaded to the website. We are using IOT platform with MATLAB analysis. It provides a channel which is used as a server for our system. In this way the system works with the help of wireless sensor network.

4. Circuit Diagram

The figure below shows the circuit diagram of proposed system.

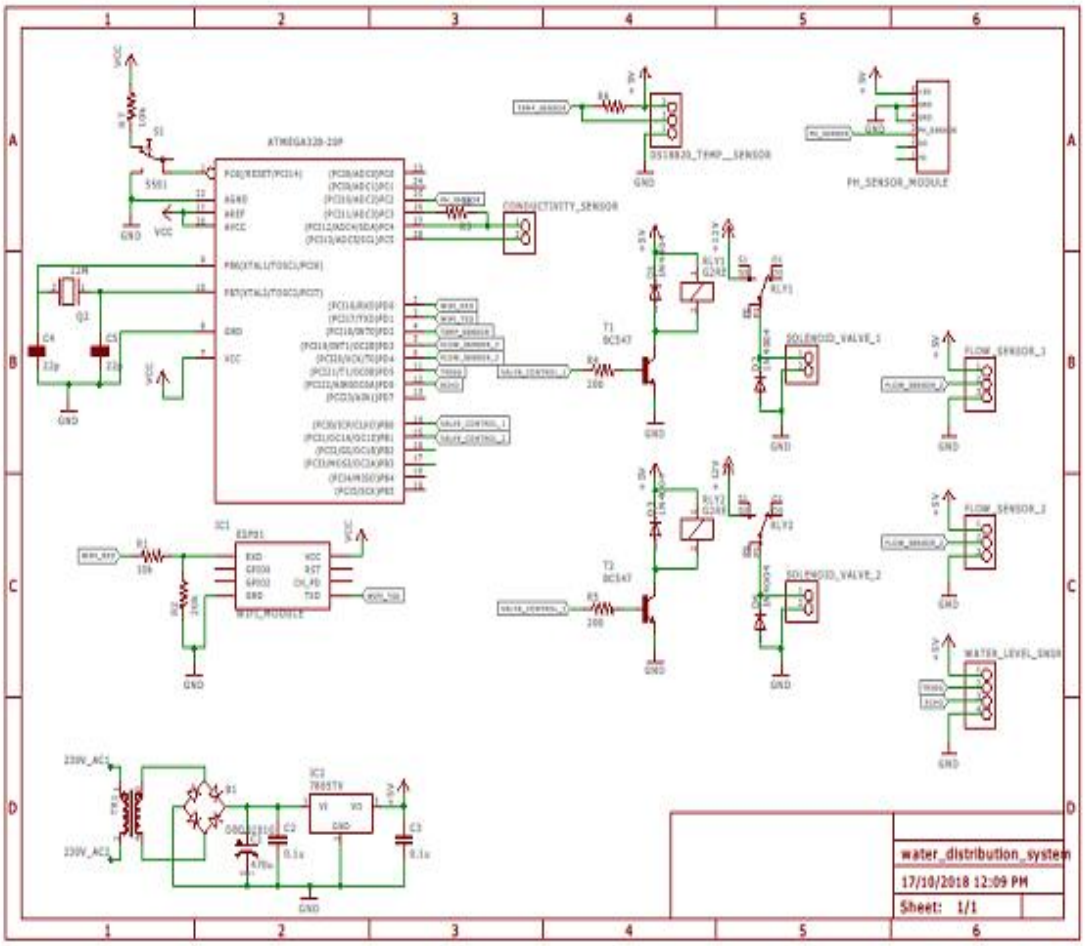

Fig2. Circuit Diagram

5. Flow Chart

The figure below shows the flow chart of the proposed system. The flow chart explains the step by step functioning of the system. First all parameters are sensed by the sensors wirelessly and then this data is send to the controller. After the data is sensed by the AtMega328P it is send to the web page with the help of Wi-Fi module.

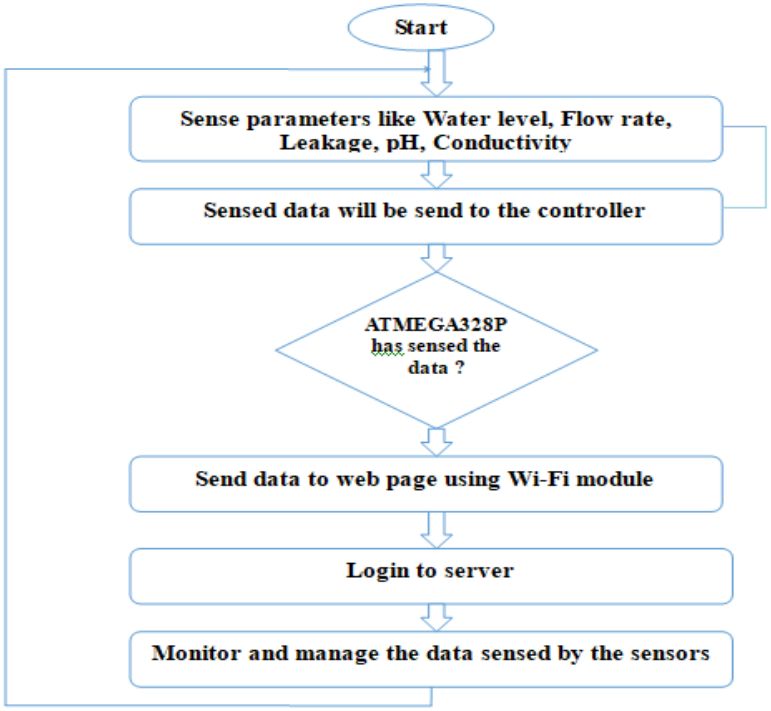

Fig3. Flow Chart

6. Hardware and Software Requirement

The hardware present in the proposed system includes various components such as AVR ATMEGA328P,ESP 8266WIFI module, nRF 24L01 transceiver, sensors such as pH sensor, ultrasonic water level sensor, flow sensor, conductivity sensor and solenoid valve for control-ling action. Easy EDA tool is the software we have used for schematic and PCB layout designing. For simulation Proteus, LAB View, EPANET these software's are being used. GUI server and programming are done with the help of MATLAB. In some cases we have used Ardunio IDE for sensors programming.

7. Conclusion

This paper demonstrates the successful implementation of smart water distribution and leakage detection system along with wireless sensor network using IOT based approach which measures the level of water, quality of water, conductivity, pH and usage of water on real time basis. The main purpose is to focus on different applications of IOT in water resource distribution and management which reduce the human efforts and overcome the drawbacks in the conventional system. The main application of this system is for Municipal Corporation for proper distribution, monitoring and management without wastage of water. Leakage is the main parameter which will also be detected and a controlling action would be taken on it. Along with this it can also be used in chemical factories, industries and for domestic application. In future we can also add the feature of automatic water billing which will be send directly to consumer on their registered number or e-mail id, and the consumer can pay it online through an android application.

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