Monitoring and Management of Water and Drainage in Smart Cities Using Wireless Sensor Networks

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Abstract - **This paper aims to present an Internet of Things based solution for smart and centralized monitoring and managing of water for smart residential/offices, smart cities, Industries etc. By using this Internet Of things-based solution we can regulate the usage of water, find out the leakage and blockage in pipelines, can detect overflow of drainage water. The information collected can be read by the users on the integrated websites using their smartphones/laptops device connected to the Internet. Basically, all the information is gathered from the sensor network which is set using NRF protocol.**

Keywords: IOT, WSN, NRF24l01, Arduino.

1. INTRODUCTION

Internet of things (IOT) refers to connect things to Internet, things are an entity that has intelligence to sense data around its environment, and send it to the Internet, where it processes the data and make it useful for engineering purpose. The Internet Engineering Task Force, IETF, provides its own description of the Internet of Things, "The Internet of Things is the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with the manufacturer, operator and/or other connected devices." [1]

All these definitions talk about the networking and data communications along with network services, which are realized by wireless sensor networks. These WSNs must be designed with sophisticated and extremely efficient communication protocols along with sensors with advanced sensing capabilities. This paper also attempts to do the same by implementing the wireless sensor network by using NRF protocol and send the sensor data on to the IOT framework by Wi-Fi module.

2. OBJECTIVES

Now a day's drinking water utility are facing various challenges, due to improper water management system hence, there is a need for better methodology for real time water management. And also, the lack of proper waste water management leads to a major challenge and problem for cities. So the objectives of this paper are to provide clean, healthy and sufficient water supply for each society. To conserve and reduce the wastage of water by implementing technique of water metering i.e. Pay as per usage for each household. To provide cleaner cities and intelligent management of drainage in the cities by monitoring real time the waste water level and blockage in drainages.

3. SYSTEM ARCHITECTURE

Basically, idea is to set a nrf24l01 wireless sensor network, where in a sensor network the master node will act as a gateway and will connect our network to internet the slave nodes will be interfaced with appropriate sensors to sense the required parameter. In our system we have configured Arduino UNO as a master node, to act it as a gateway I am connecting Arduino uno to NodeMCU board by UART connection, you can also directly interface a ESP-8266 Wi-Fi module directly with Arduino uno board. The reason I have done that is because I wanted my master, Arduino uno to just wirelessly take the sensor data from all the sensor slave nodes, with minimum data packet loss as possible.

So now the data separation i.e. from which sensor node what sensor data is coming to master node is programmed at NodeMCU board such data separation is required because when the data will be send to IOT platform, or when the data will be analysed or integrated it will be easier and plus since, such data separation programming is done on NodeMCU board which takes load off the Arduino master node that is advantageous for our system design
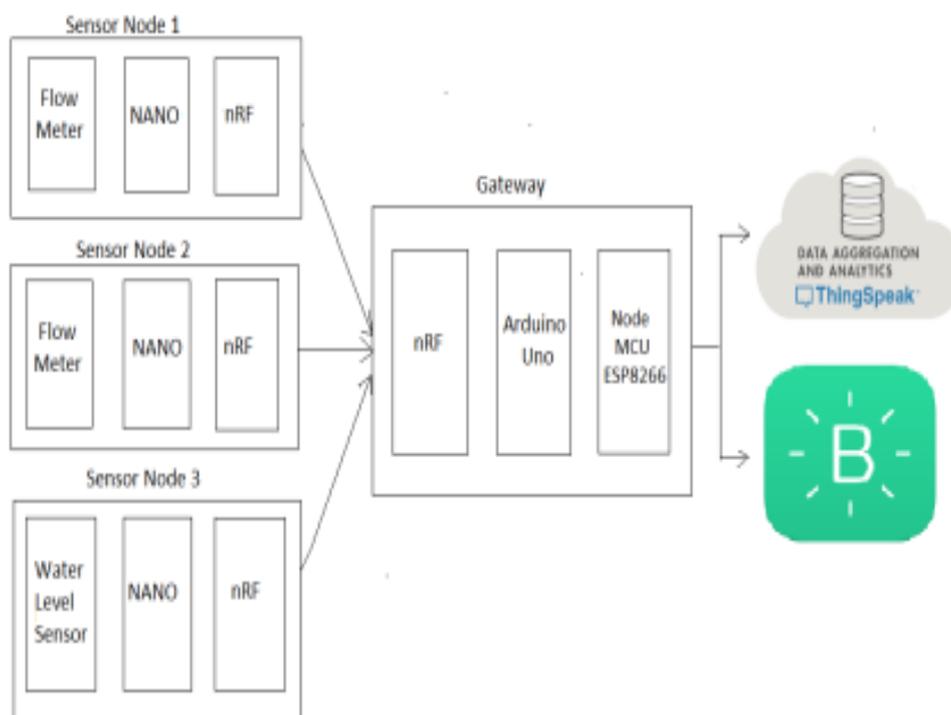
Figure 1: System Architecture

4. TOOLS AND TECHNOLOGIES

In this paper we try to make use of tools and technologies that gives reliability, simplicity, low power consumption, low cost etc. This work relies on open standard.

NRF24l01

NRF24L01 is a single chip radio transceiver for the world wide 2.4 - 2.5 GHz ISM band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced ShockBurst™ protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9.0mA at an output power of -6dBm and 12.3mA in RXmode. Built-in Power Down and Standby modes makes power saving easily realizable. If used in open space and with lower baud rate its range can reach up to 100 meters. Using this protocol use can set a network between 3125 sensor nodes.[2]

Mode

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The physical picture of our receiver node or gateway node. Here the nrf24l01 module is interfaced using SPI interface to Arduino UNO and serially communicating with NodeMCU esp8266 using UART interfacing protocol and a Buzzer is connected to digital pin of Arduino UNO for leakage Indication.

5. EXPERIMENT RESULT

Our system gives real time data of flow through each pipe, and post the data onto the IOT platform i.e. Thingspeak and also on client's mobile application i.e. Blynk application. Below figure shows the screenshot of our display panel on Thingspeak when NO Leakage is detected.
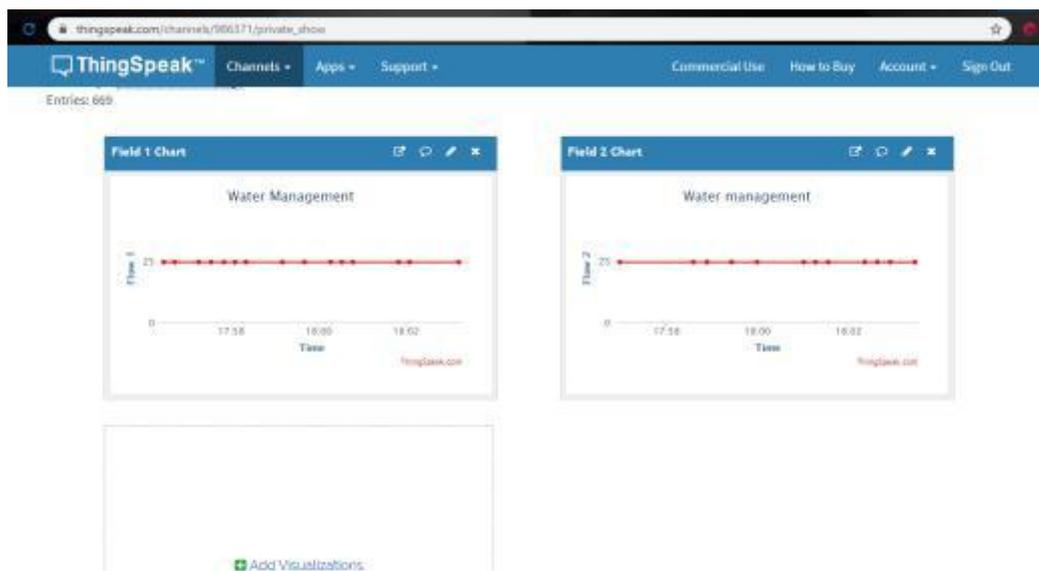
Figure 2: flow meter graph when No leakage occurs

If in case, leakage occurs the graph show difference in meter reading which is shown in the figure below.
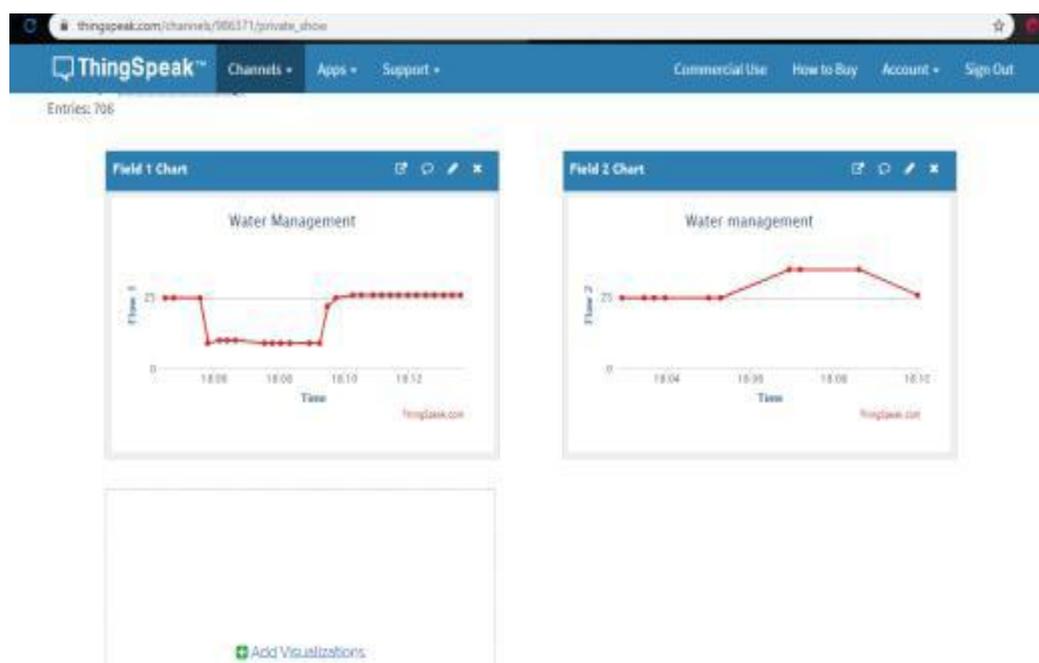

Figure 3: flow meter graph when leakage occurs

Our system also posts all the data of how much total water is consumed i.e. it provide water metering and also gives real time status of water level in storage tanks on the mobile application called Blynk application. Below figure is a screenshot of the blynk application interface that we have deigned according to our system needs.

6. CONCLUSION

The IOT and WSN will be an important technological advancement which will take the Internet and network in every domain like controlling, monitoring etc. So, we are using this technology for water management purpose. Thus it is seen in our paper that, we had set up a wireless sensor network using nrf24l01 transceiver module where all the sensor node sends the data to the base receiver module and, the base station acts as a gateway to connect this wireless sensor network to Internet using Nodemcu esp8266 module. So, as it is seen in result, the reading is visible on Thingspeak and Blynk application.

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