IoT (Internet of Things) Based Water Supply Monitoring and Controlling System

Mg Myo Thwin
Department of Electronic Engineering
Technological University (Taunggyi)
sayarmyothwin@gmail.com

Abstract: Nowadays water supply departments are facing problem in real time monitoring. Water is the most precious and valuable because it's a basic need of all the human beings. In this paper, design and preliminary results of an IoT based water supply monitoring system is proposed. The system consists of ultrasonic sensor as a water level sensor and YF-S201 as a flow sensor. Turbidity sensor (MJKDZ) is sense the turbidity of the water. Arduino UNO is used to read the sensor values from all sensors and control the water supply system. Raspberry Pi is used as a mini-computer to upload data using Python programming language to the Adafruit cloud server for monitoring.

Keywords: IoT, Python, Arduino UNO, Raspberry Pi, Adafruit

1. INTRODUCTION

Water scarcity is among the main problems to be faced by many societies and the world in the 21st century. Increasing in population many cities are facing this problem people have to suffer from this problem they don't have sufficient amount for their daily needs. There is a lack of water management ICT standards in water supply system. Some areas get water while other some areas can't so, there is a need of continuous monitoring, water supply scheduling and proper distribution. Other problems are excessive consumption, overflow of tanks, leakage in pipeline, interrupted water supply. Water is a basic need of every human being and everyone has to save wastage of water. So, with the advent of the Internet of Things (IoT), the water supply system is a natural choice for instrumentation with a network of sensors that can be communicated with each other and gather data for monitoring and automation. In this system, a smart water monitoring and automation system model is proposed with integrating Internet of Things (IoT) technologies and controller with sensors.

2. PROPOSED SYSTEM

The proposed system consists of Raspberry Pi, Arduino Uno, level sensor (Ultrasonic sensor), flow sensor, turbidity sensor and each block is explained below. The System is working on a Prototype model and shown in figure 2. The main tank is overhead tank. So, the water is flow by gravitational force. The turbidity sensor is installed in main tank and turbidity of water is presented in voltage. The turbidity of water is good condition in greater than 3.5V.

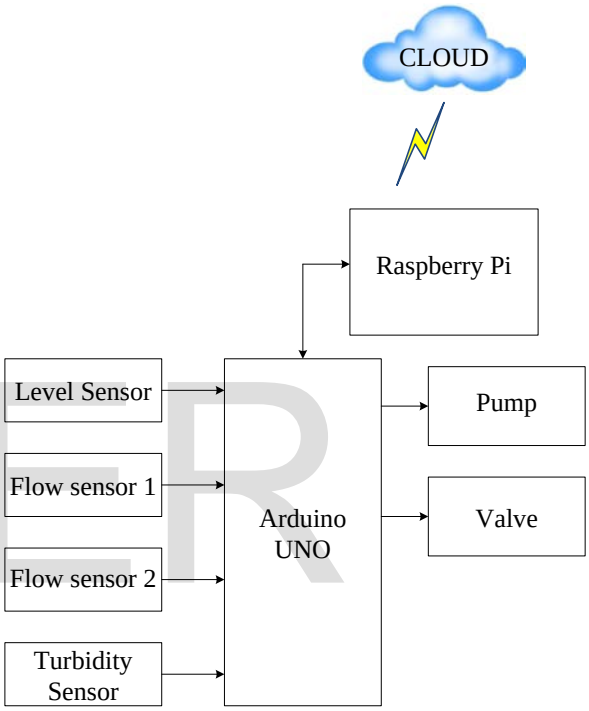

Figure 1: Block Diagram of the Proposed System

In this system, the controller reads the values of the level sensor and the two flow sensors. And then it drives the pump and valve. And also the current data of the sensors is uploaded on the cloud by the raspberry pi.

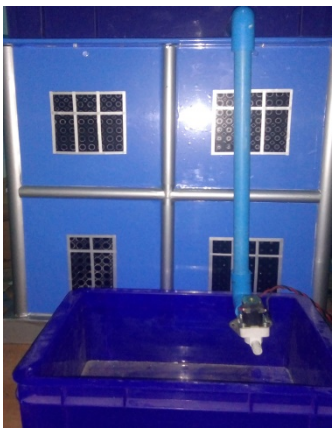

Figure 2: Prototype Model of the System

A .Raspberry Pi 3 Model B

Raspberry Pi is a low cost small and portable size of computer board. It has a high performance powerful processor and its main core language is raspbian OS which can also develop script or program using Python language. Raspberry Pi 3 Model B ARMv8 w/ 1GB RAM provides the same Pi features as before but with double the RAM and a much faster processor. The Pi 3 has Quad Core Broadcom BCM2837 64-bit ARMv8 processor and its speed is up to 1.2GHz. It has 40 GPIO pin, a built-in BCM43143 WiFi chip, allowing the Pi 3 to go wireless without additional peripherals. The Raspberry Pi 3 is also an excellent IoT solution with on-board Bluetooth Low Energy (BLE). The power source has been upgraded to 2.5A instead of 2A, allowing the Pi to power even more powerful devices over USB ports. The Pi 3 has four built-in USB ports for connectivity to a mouse, keyboard, or anything with a USB connection. Purpose of using Raspberry Pi 3 is IoT platform and to collect data from Arduino.

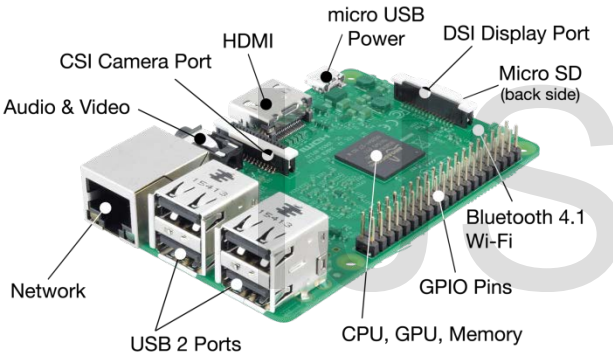

Figure 3: Raspberry Pi

Raspberry Pi receives the data from Arduino Uno by using USB cable and uploads the data to Adafruit IO by using REST API method. There are many uploading method such as MQTT Client, Node.js, REST API by using Python programming language. Among them REST API is the easiest and simplest form.

B. Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power with a AC-to-DC adapter or battery to get started.

C. Flow Sensor (YF-S201)

Water flow sensor can be used to measure the flow of liquids, i.e. the consumption of liquids in industrial or domestic usage. 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. It can measure the number of PWM pulse/interrupt per unit of time. The water flow would be directly proportional to the number of measured pulses.

D. Level Sensor (HC-SR04)

HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The Ultrasonic transmitter transmits an ultrasonic wave. This wave travels in air. When it gets objected by any material it gets reflected back toward the sensor. This reflected wave is observed by the Ultrasonic receiver module.

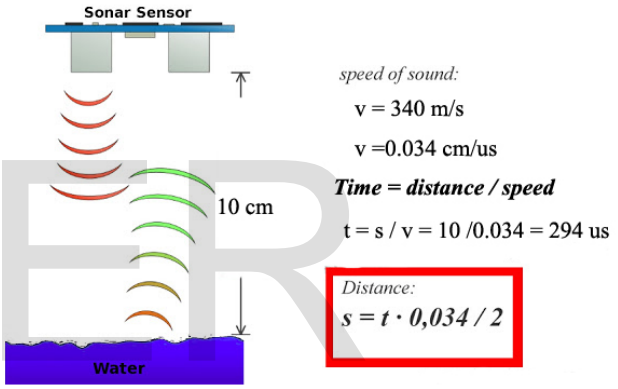

Figure 4: Distance Calculation of Sonar Sensor

E. Turbidity Sensor (MJKDZ)

This is a Turbidity Sensor with Module, an electronic monitoring module specially developed to work with microcontroller platforms Arduino, Raspberry Pi, PIC, ARM, AVR, among others. It is very efficient; the Arduino Turbidity Sensor is able to detect and verify the quality of the water, making the turbidity measurement, where it is possible to verify the results by means of digital or analog signal next to the corresponding pins in the accompanying electronic module.

The Turbidity Sensor emits at its end an infrared light, imperceptible to human vision, capable of detecting particles that are suspended in water, measuring the light transmittance and the dispersion rate, which changes according to the Amount of TSS (Total Suspended Solids), increasing the turbidity of the liquid whenever levels increase.

In general, the Arduino Turbidity Sensor is applied in projects involving the monitoring of water turbidity in rivers, streams, lakes, water bodies,

catchment and research sites, laboratories, tanks with liquids and so on. This Turbidity Sensor has an end specially prepared for direct contact, having an electronic module to amplify and send the received data to the microcontroller of the project.

F. Internet of Things (IoT)

Internet of Things (IOT) is all about collecting information from the world with the help of network devices connected and are capable of sensing and collecting the information and then sharing them on cloud where several people can access that information for different purposes. Network devices include sensors, actuators and any other physical devices. IOT implementation is considered to consist of two stages where in the first stage the devices or sensors are connected to send and receive data. The IoT application areas include home automation, water environment monitoring, and water quality monitoring etc.

F. Software

The programming language used in this system is Python and C. It is a general purpose programming language we are using Python 3.5.3 for receiving data from Arduino and posting data to the cloud. There are many different free servers for viewing data on the cloud. In this system we use Adafruit.io and it is easy to use with less errors and simple commands. The maximum storage size of Adafruit.io free server is 2G and can be save the data for 30 days. Arduino IDE (1.8.5) is used for C programming language and Thonny IDE (2.1.16) for Python programming language.

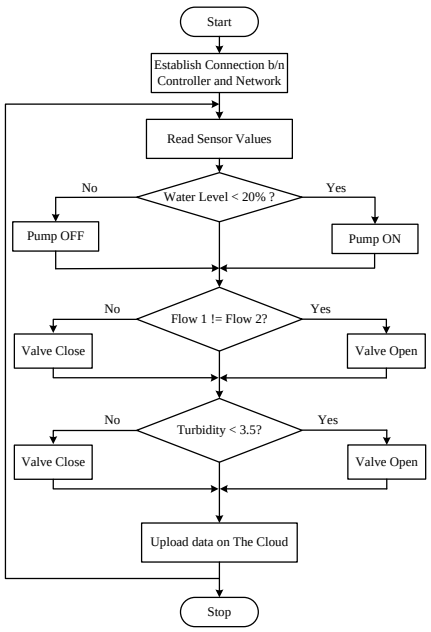

Figure 5: Flowchart of the System

3. TEST AND RESULTS

The flow rate of water is sensed by the flow sensor 1 and 2 when the water is passed through the pipeline. Arduino Uno receives the flow rate the data of the water and the data is send to the raspberry pi using USB.

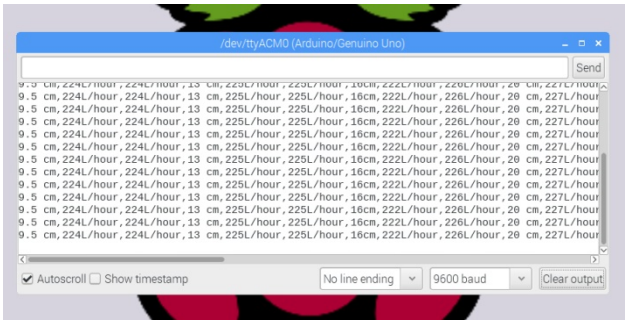

Figure 6: Viewing the Data Message of the Sensors on Raspberry Pi

And then raspberry pi uploads the receive data to the Adafruit cloud server by using Python programming language. If the values of the flow sensor 1 and flow sensor 2 are not equal, there is water leakage. Therefore the values will be closed automatically. The current and previous values of flow rates are viewing on Adafruit cloud server. The flow rate of the water is measured by liter within an hour. The flow rate of sensor 1 and sensor 2 of the water are shown in figures 4, 5, 6, 7.

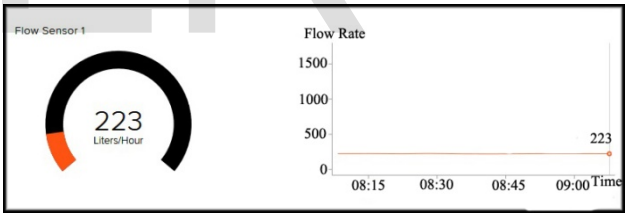

Figure 7: Viewing the Flow Rate of the Sensor 1 on Dashboard View

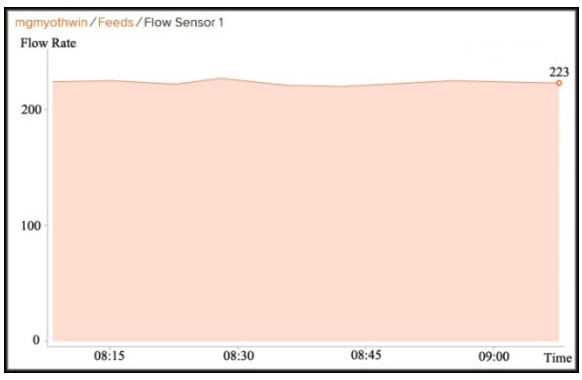

Figure 8: Viewing the Flow Rate of the Sensor 1 on Feed View

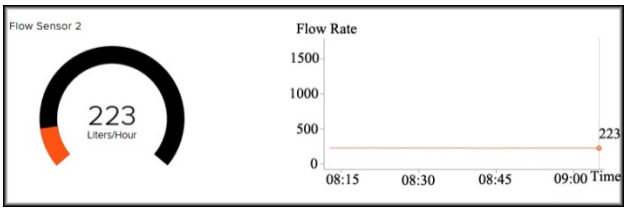

Figure 9: Viewing the Flow Rate of the Sensor 2 on Dashboard View

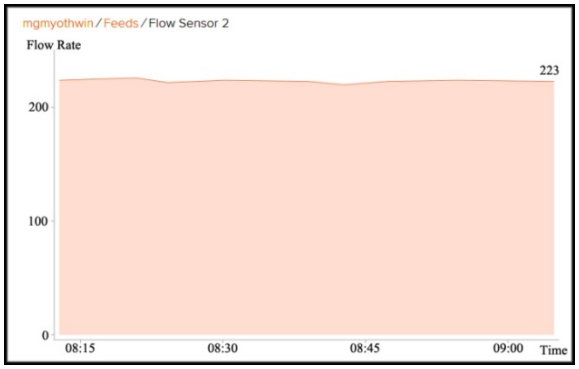

Figure 10: Viewing the Flow Rate of the Sensor 2 on Feed View

The turbidity of the water is represented by voltage and the results are shown as below.

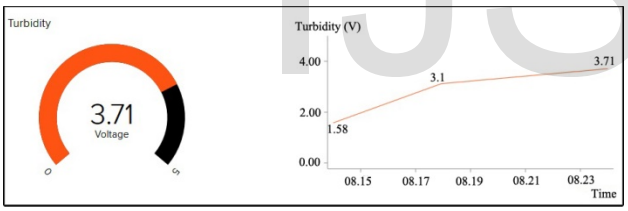

Figure 11: Viewing the Turbidity Level of Water on Dashboard View

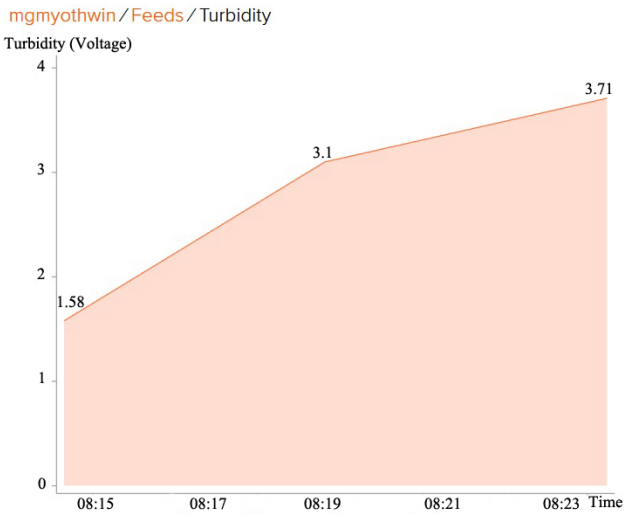

Figure 12: Viewing the Turbidity Level of Water on Feed View

The level of water is represented by percentage and the results are shown in the following.

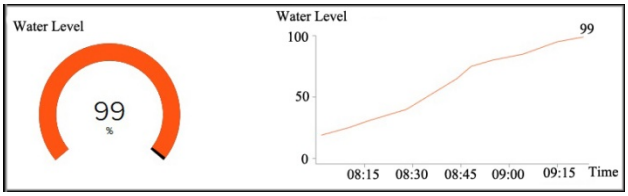

Figure 13: Viewing the Water Level on Dashboard View

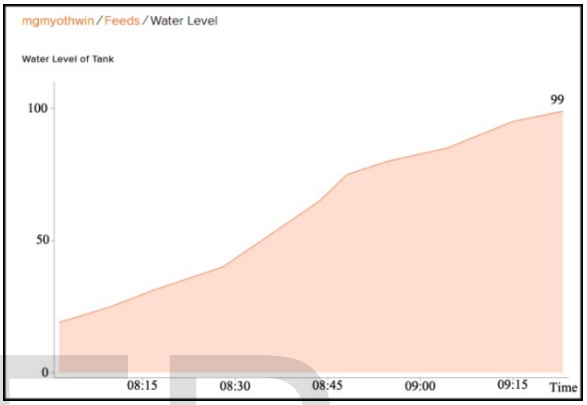

Figure 14: Viewing the Water Level on Feed View

If the level of water is less than 20%, the pump is automatically turn on and it reaches to the full range 100%, the pump is turn off.

4. CONCLUSIONS

In this paper, IoT based water supply monitoring and controlling system is presented. Arduino UNO is mainly used for controller unit and raspberry pi 3 is used for mini-computer and uploading data to the Adafruit cloud server. Arduino is easy to control for sensors, relay, pump, etc. In this system the data can be viewing anywhere in the world with internet infrastructure.

In the future, the system can be upgraded to monitor and control by the cloud server with other sensors such as PH sensor for the PH level of water, soil moisture sensor and etc.

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