IoT Based Household Water Usage Monitoring And Controlling


Abstract - In recent time's water problems due to rapid urbanization is getting worse. The sustained ground water pumping makes the ground water deplete faster. Combined with the El-Nino effect, this issue goes to the next level at an alarming rate. Even though water resource is available the major concern of people, they cannot monitor and control their water usage. During Shaving, Brushing, Hand washing people use more water than required. So regular monitoring is required to reduce the excess usage and wastage of water. IoT is used in various industries but limited to Water Management. Controlling of water consumption is also limited only to industries. Thus by incorporating IoT in daily Household Water consumption one can manage the Valuable Resource. In this project, by using IoT daily usage of water in different places of a house is visually presented in a third party web server. Gate valve of the water pipe is controlled, from the webserver by giving commands. Tank level detection setup in the tank gives us the time needed for the tank to get filled. Automatic Motor on/off system is also incorporated to operate the motor, when tank reaches a specific set valve. All these are updated in a time interval of 2 Seconds.

Index terms – IoT, Household Water, Monitoring and Controlling, Web Server.

1 INTRODUCTION

Water is vital to the entire life of our world. Surface and ground water support a variety of human uses including drinking, crop and landscape irrigation, industrial processes, household uses and recreation. Nature has given us some precious and useful tools, and water is one of them as well as our basic necessity. To live all living beings require water and to carry out their essential processes of life. The world has water-covered three-fourths of its surface area and only one-fourth has land masses Life comes from mud. Also now, millions of years later, water still remains a critical necessity of life. people can't keep track and control their water usage. Internet of Things(IoT) is one of recent times' fastest-growing technologies. IoT is used in health care gadgets, Industries, Smart home automation, Supply chain. So, the project consists of IoT to monitoring the utilization of water usage.

This project deals with the implementation of IoT based household water usage monitoring and controlling. Through integrating IoT technologies into our water monitoring system, and regulating water flow in household applications, we will reduce water overuse. The flow sensor data is used to track the level of the flow of water. High torque driven motor controls the flow of water.

The project aims to reduce water waste in household applications through the use of modern technologies, to design a system that must be able to analyze periodic water consumption in a particular pipe line. Also all data is then sent to a web server to partially control the flow of water in the pipe line and correct plots and graphs for the flow data are obtained. Also a slider in the webserver is used to control the opening of the pipe. Thus a complete controlling and monitoring of household Water consumption is done by IoT.

2 LITERATURE REVIEW

2.1 LITERATURE SURVEY

The rapid increase in industrial development combined with population density has led to greater demand far exceeding the resources available. The State Government's efforts to bridge the gap from other sources including groundwater transport have not fully mitigated the water shortage[1]. IoT technologies are considered for decoupling decision support systems and monitoring of business process coordination and implementation of subsystems. This functional architecture considers several layers and interfaces to allow interaction of layers. [2]. The operation of certain critical home appliances such as fans, lamps, air conditioners and water heaters via readings provided by different sensors mounted in different parts of the house. These sensors will all be connected to the ESP8266 MCU Node [3]. The basic operations include remote management and control of household appliances such as electric lamps; water heater etc., [4] developed an ultrasonic low-cost water level sensor capable of measuring water levels in tanks up to a depth of 10 m, and consequently volume, in different overhead tanks and reservoirs across the campus [5]. A novel household-level wireless monitoring system for water consumption is developed using the IoT model, where sensors are mounted at various detection points in a house for data acquisition, and the data acquired is redirected to a remote computer server for analysis through local WiFi and the Internet. The system was installed and tested in as many as 30 homes, 10 in Sosnowiec, Poland and 20 in Skiathos, Greece.[6]

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proposes a framework that is useful for tracking field data and for monitoring field operations, offering versatility [11]. The paper aims to make farming smart using automation and IoT technologies. The highlighting features of this paper include smart GPS-based remote controlled robot to perform tasks such as weeding, spraying, moisture sensing, scaring of birds and animals, watchfulness [7]. A low cost device to track the quality of the water in IoT setting in real time is used. Raspberry Pi B+ is used in system as core controller [10]. A specialized IOT module is added to the design framework to access sensor data from core controller to cloud. Using a special IP address the sensor data can be accessed in the cloud. The IOT module also offers Wi-Fi for accessing mobile data [8]. RS technology is used to analyze the water parameters for potential hydrogen (pH), potential for oxidation and reduction (ORP), conductivity and temperature [12]. While monitoring those parameters, it is perceived that a stable set of results should be obtained. A continuous series of anomalous measurements would therefore suggest the possible addition of a water pollutant and the user will be aware of this operation using IoT technology [9].

2.2 SUMMARY OF LITERATURE REVIEW

- Ground water level is getting lower at an alarming rate [13].
- Architecture of IoT device is growing in rapid phase [15].
- Development of Sensors using Low-Power is need of the time.
- ZigBee and Raspberry Pi are most common hardware technologies used in common [16].
- Home Automation is only in the level of tank water level monitoring setup [14].
- The development of low power, high efficient water monitoring and controlling system is needed.

3 PROPOSED SYSTEM

3.1 SYSTEM EXISTING AND ITS PROBLEMS

The prevailing system involves the user handling the water for household application by amount of flow through pipe. This is a huge process as a human have to go and turn the pipe. Manual controlling is not accurate as expected. This manually operated setup is time consuming and also tedious as the controlling valve is not usually in a hand reachable place. So, the manual operation is difficult in real time. Also there is no method to find out how much water is being consumed totally. Hence no proper conventional method is there for monitoring real time water usage.

This system has the following disadvantages

- Water wastage - Water wastage due to over usage.
- Time consuming - This process takes considerable time to change the flow valve manually.

- Manual labor - The deployment of manpower for this simple work is needed.

3.2 PROPOSED SYSTEM

The proposed method uses an easily deployable setup that has a flow meter and a gear motor controlled Gate Valve that opens and close as required. An Tank level indicator setup is used to get the tank level at any instance. By knowing the level and water reducing rate we can calculate the time this level can withstand at this flow rate. Thus by knowing this we can reduce the Water consumption by controlling the Gate valve.

The advantages of this system are

- Wastage can be reduced tremendously.
- No need of Man power and easily portable
- Less in weight and power requirement.

3.3 METHODOLOGY

The setup consists of the following sections

- Flow detection
- Flow Controlling
- Controller
- Third party Web Server.

The Flow meter data is sent to the Third party web server through the transmitter and the input from the webserver tells the controller about the gate valve value. Thus Gate valve is controlled by the controlling mechanism. The Periodic data is stored in the Webserver and retrieved when needed. Hence a Visualized data of Water consumption is achieved.

4 DESIGN

4.1 SOLIDWORKS DESIGN

Solidworks design in fig.1 shows the mechanical setup of the prototype. The Flow Sensor is placed in a PVC Pipe. Another end of the Flow Sensor is attached to Controller Holding Setup. This setup is initially attached to the PVC pipe by two L Angle. This L angle is the base of the Setup. A T joint is welded to the Two L angle and the Geared Motor is placed in that. Now Gear is meshed with the Gate Valve and Geared Motor.

4.2 ELECTRICAL CIRCUIT LAYOUT

NodeMCU V1.0 is the main controller here. It is provided with a 5V/1A power supply. Flow Sensor is attached to the D3 pin of NodeMCU V1.0. The power supply is given from the controller. Gate Valve is controlled by the Geared Motor. A Motor Driver is used to actuate the Motor. D5 and D6 are the two pins for motor actuating forward and reverse. Fig.2 shows the project electrical layout.
Fig 1: Solidworks model of the Mechanical Design

Fig 2: Electrical Circuit Design

5 FABRICATED SETUP

The mechanical setup consists of following

i. Base Pipe
   This Base pipe holds all the hardware together.

ii. Flow Sensor
   Gives the flow reading in L/ Min. This works by the principle of Hall effect.

iii. Controlling Unit
    The controlling unit has a high torque geared motor and a mesh gear. This gear is coupled with gate valve.

iv. Power Supply
   12V / 6A DC supply is given to the Setup.

v. NodeMCU V1.0
   This is the setup's principal device. It also serves for the function of IoT as transmitting unit.

Fig 4: Front Panel of the setup

Fig 4 shows the front Panel of the web server. A trial account is opened in the Thinker.io website. Then a device is added and credentials are given (This credential is important as it is programmed to the NodeMCU board). Dashboard with following data is designed.

1-Graph for Total Water Flow
   Total Water flow calculated from the time of switching On the device.

2-Graph for Instantaneous Water Flow
   Water flow at any particular given instant is obtained. The data is calculated from water flow Sensor output.

3-Water Level Indicator
   Donut Chart is shows the water level percentage in the tank.

4-Controller Slide
   This gives the command to the NodeMCU about how much the valve must be closed. Three set points 25, 50,75 % is given in the slider bar.

6. CONCLUSIONS

This machine is completely alternate for the existing manually operating system. By automating the flow rate process, high accuracy in flow is obtained. The risk of manual operation is reduced and wastage rate is decrease. The automation system is implemented by replacing the manual operation Gate valve system. All the Household and industries are benefited by implementing the automation process for flow regulating operation through IOT based system. The new system is easy to access and far more efficient than the existing system.

REFERENCES


