International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-6, August, 2019

IoT based water distribution system

D.Devasena, R.Ramya, Y.Dharshan, S.Vivek, T.Darshan

***Abstract*: In this paper, we propose an IoT-based water distribution system approach to monitor the level of water in overhead tank, flow rate of water, quantity and leakage of water in a water pipeline system based on the measurements accumulated from the flow meters and as well as proper distribution of the water resource. In urban and rural areas, the manual operation of water distribution system is being replaced. Internet of Things (IoT) technology is implemented to monitor the water distribution system wirelessly and to monitor the wastage of water. The proposed methodology is realized through the use of real-time systems and sensors, where data are collected from individual houses then processed in real-time and finally the gathered information is displayed in the website.**

***Index Terms*: Smart water city; Water Management, IoT**

I. INTRODUCTION

A water distribution system consists of different elements like pipes, valves, pumps and tanks. The pipeline arrangement helps to convey water from the source to the individual house. Designing and operating a water distribution system is the most important consideration for a lifetime of expected loading conditions. Furthermore, a water distribution system must be able to assist the abnormal conditions such as pipe breakage, mechanical failure of pipes, valves, and control systems, power outages and inaccurate demand projections. Internet of Things (IoT) technology has made a great impact in today's world.

The idea of connecting everything wirelessly made the thing easier. We can connect anything using the sensors designed specifically for objects. IoT is the network of objects, devices embedded with electronic sensors, and connectivity to enable them to talk to each other and execute functions. The devices participating in IoT must be designed in such a way that it should be interoperable with different embedded controllers as well as with different wireless technologies.

IoT is progressing with millions of things connecting each day to generate large amount of information resulting in useful future actions. This work focuses on a solution for 'Water distribution and management' in urban and rural areas with the help of IoT. Water should be conserved and the supply needs to be regulated. Water demand is exponentially growing high with the increase in population. To maintain the supply demand ration proper, it is important to have systems to prevent excess usage of water and to reduce the wastage of water. Hence an IoT system is designed with we can monitor the usage of water according to the availability.A smart water management is a two-way real-time network that consists sensors and devices that continually and remotely monitor the water distribution system. Ramratan Prajapati et.al. launched "Smart Water Management", His findings are as follows: Sensors placed in the tank gives the water level at the current time. This information will be updated on the cloud. Dipali Babubhai Paneria et.al. "Modernization in Water Distribution System", His findings are as follows: EPANET is useful to determine the flow rates, head losses due to friction, losses from the bend and handle the demand pattern. By using Water GEMS, the system problem is noted and can be tracked easily by the software. Nihesh Rathod et.al. "Towards an IoT based water management system for a campus", His findings are as follows: The wireless network uses sub-GHz radios that upload the data online for visualization and analytics. Low cost ultrasonic level sensor measure level of water in tanks in overhead tanks and ground level reservoirs across the IISC campus.

II. EXSISTING METHODOLOGY

In water tank station the water filling system is in manual mode and also there is an overflow in all the individual ground level tanks. The water distribution in both rural and urban areas is in manual mode and there is no proper monitoring of water flow in those areas. Water distribution system is used to describe collectively the facilities used to useful water.

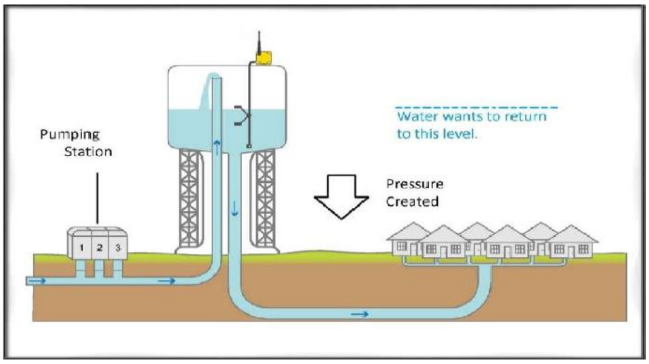

Fig 3.1 Municipal water tank

Revised Manuscript Received on October 30, 2019.

* Correspondence Author

D.Devasena*, ,Department of EIE, Sri Ramakrishna Engineering college, Coimbatore, Tamil nadu, India

R.Ramya, Department of EIE, Sri Ramakrishna Engineering college, Coimbatore, Tamil nadu, India.

Y.Dharshan, Department of EIE, Sri Ramakrishna Engineering college, Coimbatore, Tamil nadu, India.

S.Vivek, Department of EIE, Sri Ramakrishna Engineering college, Coimbatore, Tamil nadu, India

T.Darshan, student, Department of EIE, Sri Ramakrishna Engineering college, Coimbatore, Tamil nadu, India

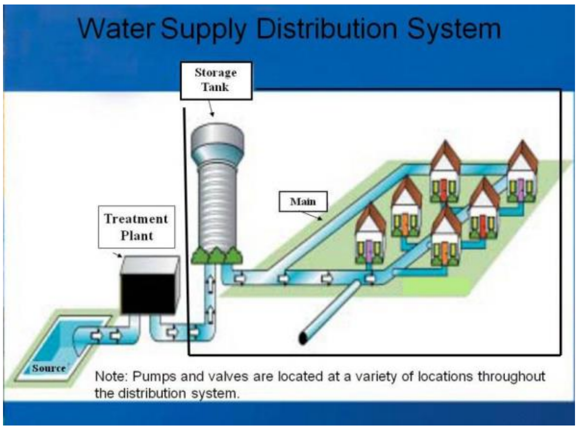

Fig 3.2 Municipal water distribution method

III PROPOSED METHODOLOGY UNITS

This project deals to monitor the amount of water present inside the tank wirelessly using the distance between the sensor and the height of the tank. The need of the ultrasonic sensor is to measure the distance between the sensor and the tank level and the data collected by the sensor will be transmitted to Arduino.

A flow meter is used in the main pipe and the branch pipe to measure the quantity of water consumed by each and every individual house in a respective region. The float switch is used in the underground tank which is used to switch the solenoid valve in the branch pipe to its on or off state based on the water level in the underground tank.

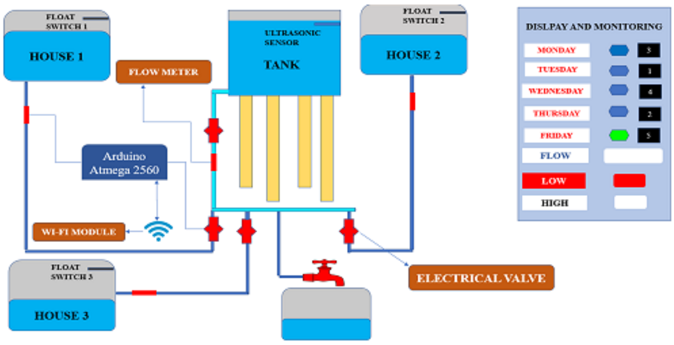

Fig 4.1 Block diagram of the proposed system

Tank which is used to store water before the water supply. A 5 liter tank is used here as an overhead tank. The electrical valve which is used to perform ON/OFF operation based on the signal from the controller. Here, a 12-volt solenoid valve is used as a electrical valve. Float switch which is used to prevent tank overflow and automatic indication when there is no water in the tank. Ultrasonic sensor which is used to measure level of the tank. This gives distance in centimeters within a 2 cm to 450 cm range. This is then converted into percentage of water in tank. Controller Arduino Atmega328p microcontroller is used here. Wi-Fi module Node Mcu ESP8266 serving as a Wi-Fi adapter, wireless internet access is added to microcontroller through UART interface which is used to monitor the level of overhead tank, flow rate of water and the water usage of individual house. Flow meter this indicates the flow rate of water from the tank.

IV. HARDWARE AND SOFTWARE DESCRIPTION

Ultrasonic Sensor

Ultrasonic sensor uses ultrasonic waves to detect object or to measure the distance between itself and the object. Ultrasonic waves are those waves whose frequencies are beyond the normal hearing limit i.e. it is more than 20 kilohertz. Ultrasonic sensors will have two transducers. One for transmitter and other for receiver. The transmitter emits ultrasonic waves at a frequency of 40 kilohertz and these waves travel to the air. When they are blocked by an object these waves get reflected and they are bounced back to the sensor.

The receiver receives this signal and converts it to an electric signal. The distance is calculated using the simple formula distance equal to speed multiplied by time.

Solenoid valve

It is an electromechanically operated valve. It is fitted on to the pipeline. The valve actuates when the relay trips. Till then the valve is in shut over (off position). Solenoid valve consists of a coil. When the supply is given the current flows through these electromagnetic coils. Thus, it energizes the coil. This coil due to magnetic field pulls up the valve.

Wi-Fi module

A WiFi module is used to communicate with the microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate. These are used to monitor the flow rate of water and usage of water in the individual house.

Real Time Clock (RTC)

RTC chips are used in an embedded system whenever the date and time are needed to be displayed (e.g. on an LCD), or data needs to be time stamped before it is logged to an SD card or sent via a USB cable or wirelessly to another device. It is often packaged in a separate chip so that it can be powered by its own battery, such as a 2032 coin cell. This allows the main circuitry on the board, including the microcontroller to be completely powered down, and the RTC will keep running. The communication between the microcontroller and the RTC chip will generally be over a serial interface such as I²C or SPI. Typically, the RTC chip will have a number of registers, each with their own address, which can be written to or read from the microcontroller. These registers would include the date and time, usually one field per register (month, day, year, hour, minute, second and sometimes weekday).

Flow meter

A flow meter consists of a rotating wheel which generates the analog value of current when a liquid flow through it.

It measures flow rate of water flowing in the pipeline.

It can measure the quantity and velocity of the flowing fluid $Q = A * v$. In other words, the quantity of water can be determined by measuring the time interval between the opening and closing of valve and multiplying it with the flow rate of water.

Retrieval Number D6295048419/2019©BEIESP
DOI: 10.35940/ijeat.D6295.088619
Journal Website: www.ijeat.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

The mass flow can be expressed in a mass flow meter as follows: $\dot{m} = Q * \rho$ (where Q is the volumetric flow rate and ρ is the fluid density).

Relay

Relays are one of the most simplistic components and also important because relays are the link between the low power digital electronics and high-powered devices. Relays allow digital circuits and digital microcontrollers to switch high powered devices on and off. Relay is an automatic protective and switching device which is capable of sensing abnormal conditions in electrical circuits. Relay consists of a coil which builds up the magnetic field when current is passed through it. This magnetic field will pull the switch into the closed position to allow the current to flow from the other side. The classifications includes electromagnetic, solid state, high voltage, thermal relays.

V. RESULTS AND DISCUSSION

The results were obtained from thing speak and the results are displayed in figure. The first condition is that RTC sends the digital input of the time to the Arduino based on which the main valve will be opened. The second condition float switch detects the level of the water in the ground level tank and acknowledge the controller to open/close the solenoid valve on branch pipes.

When the tank level increases or decreases in the overhead tank the ultrasonic sensor will detect the change and the values are obtained by the microcontroller. RTC sends the digital input of the time to the Arduino based on which the main valve should be opened. When the level of the water in the ground level tank reaches its maximum value then float switch detects and acknowledge the controller to close the solenoid valve on branch pipes. The status of water level will be displayed in the Liquid Crystal Display (LCD). The flow rate of water is measured using flow meter fitted in the main and branch pipes. So, the leakage of water also can be detected.

The quantity of water consumed by each and every individual house in a respective region is obtained by measuring the flow rate and the time interval between the opening and closing of solenoid valve. The data from the sensor is received by the microcontroller and uploaded in the internet. A web server will be utilized for non-android users.

Table 1 Level of water in overhead tank

Time (in hour:min)	LEVEL OF WATER IN OVERHEAD TANK (in cm)
15:00	32
18:00	31.5
21:00	31
9:00	30

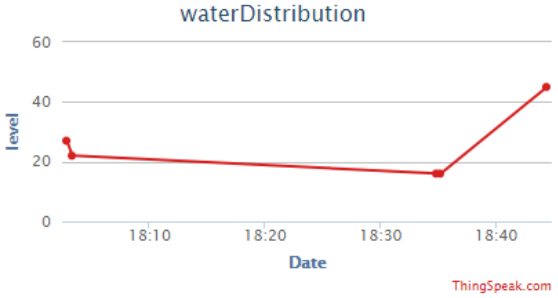

Fig 4 Level measurement of water in overhead tank

Time (in hour:min)	FLOW RATE IN OVERHEAD TANK (in cm^3/s)
15:00	155
18:00	156
21:00	177
9:00	179

Table 2 Flow rate of water in ground level tank

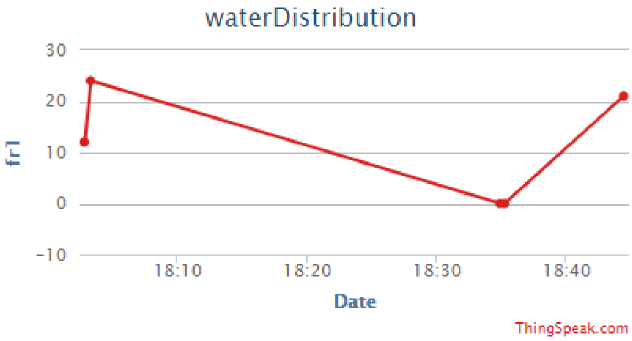

Fig 5 Flow rate of water in ground level reservoir

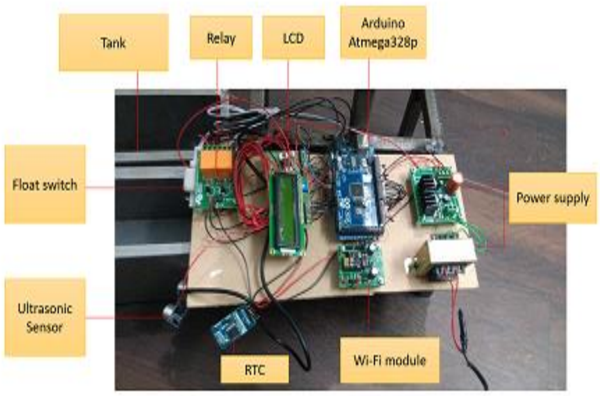

Fig 6 Experimental setup of the proposed system

Retrieval Number D6295048419/2019©BEIESP
DOI: 10.35940/ijeat.D6295.088619
Journal Website: www.ijeat.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

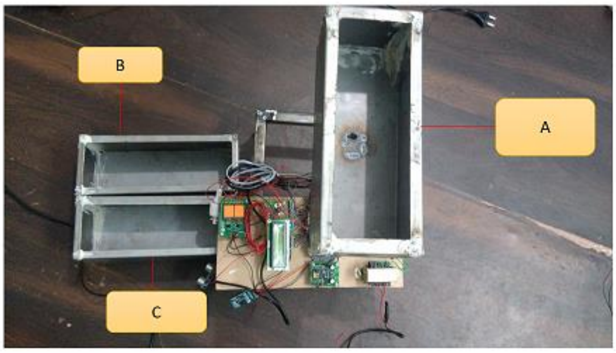

Fig 7 Top view of the proposed system

A-Overhead Tank
B-Ground level Tank 1
C-Ground level Tank 2

VI. CONCLUSION AND FUTURE SCOPE

This project addresses the environmental features like durability, affordability, prevention against leakage and maintenance issues. Hence this system avoids excess usage of water, wastage of water and promises efficient water management system. The future scope is to develop the system using PLC. This helps in improving the reliability and durability. A greater number of nodes can be included and also replacement for a particular component can be made easily. To develop an app in which the local residents can monitor their consumption of water

REFERENCES

1. Van der Steen and Peter, (2016), 'Integrated Urban Water Management: towards sustainability', Environmental Resources Department UNESCO-IHE Institute for Water Education, Vol.2, No.3, pp. 105-425.
2. Rohini Sharma, (2011), 'Internet of Things: An approach for Advancement in Educational Institution', Department of Computer Science and Applications, Panjab University, Vol.2,No.5, pp. 32-45.
3. Kawase Y., Ohdachi Y., (2013), 'Dynamic analysis of automotive solenoid valve using finite element method', International Journal of Electronics & Computer Engineering, Vol.27,No.7,pp. 3939 - 3942.
4. Uchiyama M., Hakomori K.,(2014), 'Measurement of instantaneous flow rate through estimation of velocity profiles', IEEE Transactions on Automatic Control, Vol.28,No.3, pp. 380-388.
5. Liu X., Liu H., Wan Z., Chen T. and Tian K., (2015), 'Application and study of internet of things used in rural water conservancy project', Journal of Computational Methods in Sciences and Engineering, Vol.15,No.1, pp. 477–488.
6. Hassan M.N., Chong T.L., & Rahman M.M., (2012), 'Solid Waste Management-What's the Malaysian Position', Seminar Waste to Energy, University Putra Malaysia, Vol.5, No.3, pp. 225-567.
7. Latifah A., Mohd A.A., & NurIlyana M., (2013), 'Municipal solid waste management in Malaysia: Practices and challenges of Waste Management', IEEE Journal, Vol. 29, No.6, pp. 2902-2921
8. Priyen P. Shah, Anjali A. Patil Subodh, S. Ingleshwar, (2017), 'IoT based smart water tank with Android application', International Conference on ISMAC, Vol.4, No.9,pp. 19 - 342.
9. Sapna Suryawans B. Marimuthu, K. Chithra, (2017), 'Ultrasonic water level indicator and controller using AVR microcontroller', International Conference on Information Communication and Embedded Systems, Vol.3, No.5, pp. 25-44.
10. Rohini Bhuse, MeghaGite, Dhanashri Hande, (2017), 'Waste Management System Based on IoT', Matoshri Collage of Engineering & Reasearch Centre, Vol.5, No.2, pp. 1835-1837.

AUTHORS PROFILE

Mrs.D.Devasena has received his Master's Degree in Communication Systems from Anna University, Coimbatore in 2010 has received her Bachelor's Degree in Electronics and Instrumentation Engineering from Maharaja Engineering College, Anna University Chennai in 2006. Currently she is pursuing her Doctoral Degree in the Faculty of Information and Communication Engineering from Anna University Chennai. She has 8 years of experience in teaching. Her research interests are in Denoising in Image Processing, VLSI Implementation. She has presented papers in National Conferences, international conference and International Journals.

Mrs.R.Ramya pursuing her Ph.D in Information and Communication under Anna University, Chennai. She is obtained her Post Graduate degree in Applied Electronics from Anna University of Technology, Regional Centre, Coimbatore She completed her Under Graduate Degree in Instrumentation and Control Engineering. She started her career as lecturer in the Department of Electronic and Instrumentation Engineering at Sri Ramakrishna Engineering College. Her research interests are in the field of Sensors and Instruments and Medical Image Processing. She has published papers in International journal and International and national Conference. She is life member in ISOI, ISTE professional bodies.

Mr.Y.Dharshan has Master's degree in Control and Instrumentation Engineering from Regional centre of Anna University in the year 2015 and Bachelor's degree in Instrumentation and Control Engineering from Tamilnadu College of Engineering, Coimbatore in the year 2011. His areas of interest are Control Systems, and Automation. He has also attended workshops and seminars held in various colleges in Tamilnadu. He has 4 years and 6 months of teaching experience.

Mr.S.Vivek completed his Post Graduate degree in M.E. Embedded System from Bannari Amman Institute of Technology. He completed his Under Graduate degree in B.E. Electronics and Instrumentation Engineering from Sri Ramakrishna Engineering College. He began his career as an Assistant Professor in the Department of Electronics and Instrumentation Engineering, Sri Ramakrishna Engineering College. His research and teaching interests include Image Processing, Embedded systems, Automobile, Biomedical Instrumentation. He has done Industrial project for Bimetal Bearing Ltd. worth of Rs.2.5 lakhs in the field of machine vision.

Mr.T.Darshan completed his Under Graduate degree in B.E. Electronics and Instrumentation Engineering from Sri Ramakrishna Engineering College. His research interests are sensors and transducers, IoT, Automation, and Biomedical Instrumentation.