2023 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics (IITCEE) | 978-1-6654-9260-7/23/$31.00 ©2023 IEEE | DOI: 10.1109/IITCEE57236.2023.10091019

IoT based Smart Water Meter for Water Management

Amith B R
Department of Electronics and Communication Engineering
BNM Institute of Technology
Bangalore, India
amithbr.ramesh@gmail.com

Aniket S Kadam
Department of Electronics and Communication Engineering
BNM Institute of Technology
Bangalore, India
skaniekt56@gmail.com

Aditya Kulkarni
Department of Electronics and Communication Engineering
BNM Institute of Technology
Bangalore, India
adityakulkarni880@gmail.com

Prof. Priya R Sankpal
Department of Electronics and Communication Engineering
BNM Institute of Technology
Bangalore, India
priyarsankpal@gmail.com

***Abstract* - Natural resource obtainability and depletion are gradually being known as restrictive aspects for sustainability. Water is a major concern, particularly in nations that are experiencing drought and hence the water management. At the consumer end water distribution and pricing are the essential commercial elements of water management. In urban cities water consumption is measured manually by municipal officials from a meter fitted at individuals. For gated communities or large apartment complexes, water consumption expenses is equally divided amogh the entire occupancy of dwelling. The expenses related to consumption should be volumetrically priced for the residents rather than equal amount. This paper proposes IoT based smart water meter reading, that measures water consumed at individual blocks in gated communities/apartment complexes and computes it's volumetric pricing. This data is then sent to cloud platforms for monitoring. By monitoring the usage, conservation of water can also be done.**

***Keywords* – smart city, volumetric pricing, IoT, smart metering, water consumption.**

I. INTRODUCTION

"Smart cities" are a concept that interests urban planners, corporations, and international organisations. It indicates the beginning of a new era of better infrastructure management that connects individuals, locations, and objects. Few of the problems faced are waste management, traffic in the city. Waste management in cities is done by segregating the municipal waste into domestic, commercial and industrial waste. Further it's divided into dry and wet waste for easy processing of the waste also recyclable waste are segregated as well. Traffic management in cities are done using different image/video processing algorithms which checks the number of vehicles and let the traffic flow where there are more vehicles even traffic rule breaker can be recognised using these image/video processing algorithms. Another one such challenge faced in the city is water management and the pricing for the amount of water used. All the residents in the apartment pay water bill which is an equal amount of maintenance fee regardless the number of members in a house. This can be solved by implementing smart technologies at urban scale by using sensors, smart meters and smart network etc.., Water meters are fitted in gated communities, that are used to generate bill for total consumption amount which is divided equally among the tenants in the apartment. By using smart meter, solution for this problem and the monitoring of the usage level for the water consumed are given. The charges are collected based on the consumption of each family instead of total consumption of all tenants. Monitoring the consumption of water will prevent over usage of water.

II. LITERATURE SURVEY

Gurung Ram [6] reports how smart metres can handle the demands of modern water supply system more effectively and handle complexity better. The proposed work of concentrated on the best network planning for the water infrastructure.

P. Verma, [7] discuss the design and preliminary results of an IoT based system for management of the water distribution system in a large campus. In particular, we focus on two specific components of the system: a low-cost ultrasonic based water level sensor and a sub-GHz based campus scale wireless network to connect the sensors

Manmeet Singh, Suhaib Ahmed, [1] IoT based smart water management systems: A systematic review, which discusses the architecture and various components of IoT based water management system in detail followed by in-depth survey of all existing IoT based water management systems

Sarah Darby [8] introduced an idea of affordance, and then using the theory of affordances, qualitative data is investigated to determine how householders consumed with and without smart metres. The switch to lower-impact energy systems was based on Advanced Metering Infrastructure (AMI). AMI offered options to manage

domestic energy use and improving customer experience.

Tracy C. Britton [9] shared his idea about water utilities to improve water distribution System and reduced the amount of water lost in the network. It estimated the customer post meter leakage for up to 10% of total water consumption and concluded that water loss was reduced by finding post meter leakage

K. Mohammed Shahanas, P. Bagavathi Sivakumar, [10] Proposed Framework for a Smart Water Management System in the Context of Smart City Initiatives in India.

Cara D. Beal [11] cited a research study that had demonstrated how regular homeowners' perceptions of their water consumption did not match their actual water use. This study looked at how much each category of people who self-identified as "low," "medium," or "high" water consumers contributed to overall water use. A degree of information was provided to the customers based on their water bill.

Fernando Arbues [12] cited a paper that centred on number of members in a household. They calculated a residential water demand function that includes multiplicative dummy variables, allowing them to determine whether users' demand is increasing or decreasing.
Seung Won Lee, Sarper Sarp, Dong Jin Jeon & Joon Ha Kim [13] introduced a methodology for smart water grids (SWGs) for use in water management, which integrates information and communication technology (ICT) into a single water management plan.

M. Mukta, S. Islam, S. D. Barman, A. W. Reza and M. S. Hossain Khan [14], proposed an IoT (Internet of things) based smart water quality monitoring (SWQM) system that aids in continuous measurement of water condition based on four physical parameters i.e., temperature, pH, electric conductivity and turbidity properties.

III. RELATED WORKS

Apartment tenants typically aren't aware of how much water they use on a daily basis. The BWSSB (Bangalore Water Supply and Sewerage Board) placed a common water meter that monitors the entire apartment complex but not individual flats. Each resident typically pays their fair share of the monthly water bill calculated using this meter. But starting of May 2020, the BWSSB enforced a new law requiring internal water meters in every apartment in apartment buildings. These meters must be installed within each apartment's boundaries:

- All current structures with three or more houses that have a total area of at least 2,400 square feet.
- All future structures with three or more dwellings that have a total area of at least 1,200 square feet.

Fig 1: Water meters installed on the pipelines going to individual flats

Internal metering was installed in an apartment, a 120-unit complex in HSR Layout that is also a member of the Bangalore Apartment Federation (BAF), and it cut water consumption by 30–35%. However, the installation had some initial difficulties.

The seller proposed putting a water metre for each of the three to four water inlets in each apartment. The estimated price was Rs 15.6 lakh. PVC pipes were fitted in place of the earlier used GI pipes to connect directly every flat to the upper tank. They fitted mechanical metres to measure water flow, but the water was sometime too hard, clogging the metre and shutting off the water supply.

Metering had been implemented in a 26-unit compound in Ulsoor roughly two years ago. Water usage has been cut by at least 30%, and in a few cases by up to 50%, and power use for pumping water has also been significantly decreased. Because the plumbing was old and each flat had 4-5 inlets, it had to be redone here as well. The rent for each flat was roughly Rs 20,000. Because mechanical meters could become blocked as a result of hard water, they used ultrasonic meters.

IV. METHODOLOGY

The YSF-201 water flow sensor is connected to an Arduino UNO microcontroller that has Arduino code embedded in it to implement the suggested approach. The amount of water flown and the cost for the water used are displayed in the serial monitor and OLED display, respectively, using the Arduino IDE software.

i. Hardware Requirement:

The Arduino UNO is a microcontroller board that features an ATmega328 dual inline package (DIP) microcontroller that is detachable. It includes 6 analogue input pins and 14 digital Input/Output pins. It runs on 5 volts.

YF S201 Water flow sensor: A water flow sensor that measures the amount of water that has been moved from one location to another. It is made up of a turbine wheel, a plastic valve body, and a hall effect sensor. Every time the magnetic field changes, the hall effect sensor outputs a pulse.

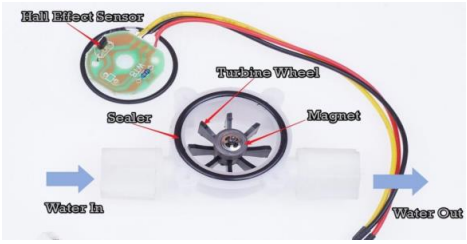

Fig 2: Waterflow sensor

ii. Software Requirements:

The code is written in the Arduino IDE and uploaded to the Arduino UNO for use and testing.

V. PHYSICAL IMPLEMENTATION:

Based on the number of pulses generated by due to the change in magnetic field when the water flows through the sensor the volume is calculated. According to the datasheet for the YF S201 sensor, the hall effect sensor in the sensor produces 450 pluses for every litre of water that passes through it.

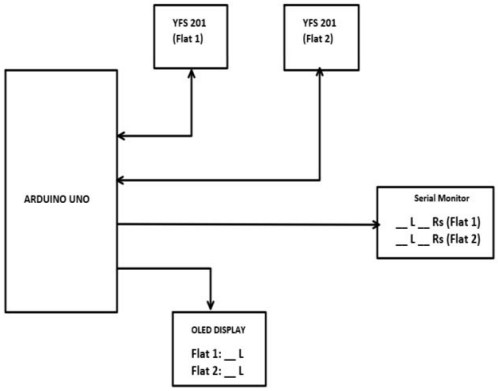

Fig 3: Block diagram of Implementation

The water flow rate is measured using two sensors. The amount of fluid that moves per unit time is known as the water flow rate. Water flow sensors are frequently employed in systems for water heat control, cafe machines, water vending machines, and soft drink industries etc. which gives a fixed quantity of water to be dispensed.

The Arduino UNO is interfaced with the two sensors to determine the volume, flow rate, and cost of the utilized water. A 0.96' I2C OLED Display that is connected to an Arduino UNO displays the computed capacity in Liters.

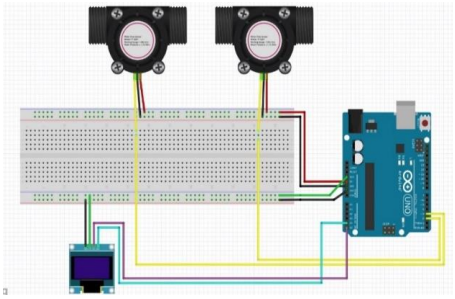

Fig 4: Arduino UNO connection with sensor

The connection between Arduino UNO and Waterflow sensor is as shown in the fig 4.

The water flow sensor's output can be read using the loop function. In the event that a high level is read, add number plus one. This is not suitable for live -time, though, and each loop execution of the program requires a delay or a no operation instruction during which new pulses cannot be detected. For such live-time demanding applications, interrupt is commonly employed. An interrupt is executed when the rising edge of the pulse is noticed, by incrementing the count by one.

Formula for calculations of water flow rate is:

The volume of water passing through the turbine is fixed for each rotation. In addition, a specific number of pulses are produced by the turbine during each rotation. As a result, we are able to create an equation relating the quantity of pulses to the water flow. For the YF-S201, the Hall Sensor produces 450 pulses for each litre of water flowing. 1 litre requires 450 pulses, so each pulse results in 1/450 litre of water flowing through.

Total volume (Vol_total in unit Litre) is defined as the total amount of liquid flowing through the water flow sensor at time T (unit sec), and 'N' as the total number of pulses detected. Next, we have:

Vol_total (Litre) = N*(1/450).

Vol_total(Litre) = R(Litre/sec) *T(sec);

N* 1/450 = R(Litre/sec) *T(sec);

N/T = 450 * R(Litre/sec);

N/T is number of cycles per unit second that happen to be frequency Freq(Hz), so:

Freq= 450*R(Litre/sec);

R(Litre/sec) = Freq/450;

R(Litre/minute) = Freq*60/450 = Freq/7.5;

R(Litre/Hr) = Freq*60*60/450 = Freq*60 /7.5

VI. EXPERIMENTAL RESULTS

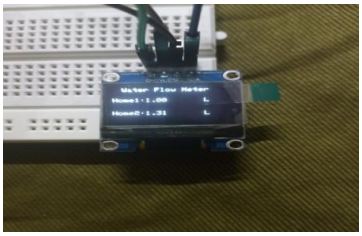

Fig 5: OLED display

Fig 5 shows the amount of water flow through the two waterflow sensor in Litres. This displays the amount of water flow through the flat1 and flat2.

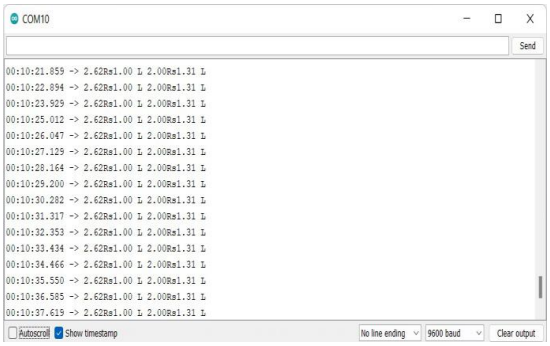

Fig 6: Serial Monitor window

Fig 6 shows the serial com port that displays amount of water flow through two water flow sensors in terms litres and specific amount is calculated corresponding to the water used and amount is displayed in terms of Rupees.

VII. CONCLUSION

In this paper, implemented a methodology to measure the water flow in two flats of gated community/apartment complex. Smart water metres are gadgets that track how much water is used by apartment members based on the individual household consumption. Pricing based on individual consumption cuts down the water consumption and hence the burden of sharing the water expenses equally. In many apartments, water conservation and management are a major problem and with smart water meter implementation water conservation may be addressed.

REFERENCES

[1] Manmeet Singh, Suhaib Ahmed, IoT based smart water management systems: A systematic review, Volume 46, Part 11,2021, Pages 5211-5218.

[2] Gibbs, D.; Krueger, R.; MacLeod, G. Grappling with Smart City politics in an era of market triumphalism. Urban Stud. 2013,

[3] Glasmeier, A.; Christopherson, S. Thinking about smart cities. Camb. J. Reg. Econ. Soc. 2015.

[4] De Jong, M.W.; Joss, S.; Schraven, D.; Zhan, C.; Weijnen, M. Sustainable-Smart-Resilient-Low Carbon-Eco-Knowledge Cities: Making sense of a multitude of concepts promoting sustainable urbanization. J. Clean. Prod. 2015.

[5] March, H. The Smart City and other ICT-led techno-imaginaries: Any room for dialogue with Degrowth? J. Clean. Prod. 2016.

[6] Gurung, Ram, Stewart, Rodney, Beal, Cara, K. Sharma, Ashok" Smart meter enabled water end-use demand data: platform for the enhanced infrastructure planning of contemporary urban water supply networks" Published at Journal of Cleaner Production, 2014.

[7] P. Verma et al., "Towards an IoT based water management system for a campus," 2015 IEEE First International Smart Cities Conference (ISC2),2015, pp.1-6

[8] Sarah Darby," Smart metering: what potential for householder engagement? "Published at BUILDING RESEARCH & INFORMATION, UK,2010

[9] Tracy C. Britton a, Rodney A. Stewart b, *, Kelvin R. O'Halloran c," Smart metering: enabler for rapid and effective post meter leakage identification and water loss management Tracy" Published at a Journal of Cleaner Production, 2013.

[10] K. Mohammed Shahanas, P. Bagavathi Sivakumar, Framework for a Smart Water Management System in the Context of Smart

City Initiatives in India, Procedia Computer Science, Volume 92,2016,

[11]Cara D.BealRodney, A. Stewart Kelly Fielding ”A novel mixed method smart metering approach to reconciling differences between perceived and actual residential end use water consumption” Published at Journal of Cleaner Production,2013,

[12] Fernando Arbués, Inmaculada Villanúa, Ramón Barberán,” Household size and residential water demand: an empirical approach” Published at the Australian journal of agriculture and resource economics,2010

[13] Seung Won Lee, Sarper Sarp, Dong Jin Jeon & Joon Ha Kim (2015) Smart water grid: the future water management platform, Desalination and Water Treatment, 55:2, 339-346, DOI: 10.1080/19443994.2014.917887

[14] M. Mukta, S. Islam, S. D. Barman, A. W. Reza and M. S. Hossain Khan, "Iot based Smart Water Quality Monitoring System," 2019 IEEE 4th International Conference on Computer and Communication Systems (ICCCS), 2019, pp.669-673.