An apt water meter based on IoT and a database for keeping track of the flow of water.

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***Abstract*——** **A unique approach to read water meters using the smart automated metering technique, for the information of water consumption from the field directly to the owner using IoT methods. The apt water metering approach is different from conventional methodologies as the apt water meter will be cost-effective and user-friendly. This smart water meter measures daily water consumption and provides live data on our smartphone which is connected to a database. Also, monitoring of daily consumption helps to cut off wastage of water which leads to the key component of the water management system. These data can be accessed online from any provided region. This proposed scheme can save time by eliminating the manual meter reading and enable a flexible billing cycle in metropolitan cities.**

Keywords: IoT, smartphone, database, user-friendly, owner, water management system, flexible billing cycle, metropolitan cities.

I. INTRODUCTION

Throughout the world, technological trends have accelerated our ability to modify the environment we live in. These technologies not only improve the world but also reduce the environmental effects [1]. Due to the increase in population, the water demand is increasing rapidly. Consumption and wasting of water, billing cycle, storage, excess use of water, and some other factors have caused serious problems around the globe [2]. Due to these problems, there is a water scarcity, which is affecting the large population to remain deprived of drinking water.

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The existing water meters have some drawbacks, these include

1. The majority of meters are also tricky to urge, so customers cannot easily read their meters.
2. Water meters need to be physically read at a group interval, a process that will be both labor and time-intensive.
3. While the smart meter provides accurate and frequent data 24/7.
4. The user can use the web mode to see their daily consumption giving them greater control of their water use and their bills.

Now a day, conservation is a big issue in many localities with the common meter. The problem is cumulative billing for consumption of water; the amount is to be shared among the households, where they're being charged quite what's to be paid. So that they need a system under which charges are levied as per consumption of every family rather than total cumulative consumption thus, the association should take initiative to send the message of the quantity of water consumed to all or any residents.

The solution for the above-mentioned issue is often solved by installing a sensible meter.

It measures the amount of water consumed by each household and permits the user to observe the consumption level. While

Installing this smart meter we should always avoid the above issues which we should keep track of the water consumed online. The availability of water is often ended if the residents aren't present in their homes and it reduces energy consumption [3].

II. AUTOMATED METERING AND SMART METERS.

New development in the electronic world has brought automated metering infrastructure (AMI) into creating smart water management systems. Smart water meter offers bi-directional communication between a customer and the utility.

A “Smart Metering” or “Intelligent Metering System” is associated with an electronic system that measures overall energy consumption and provides more necessary knowledge than a traditional meter. These apt meters will transfer and receive knowledge through transmission. Apt Metering offers utilities with two-way communication to the meter [4].

The ancient meter reading method involves the victimization of the analog meters to gather the information of the energy consumed and show it either on a variety dial or a display. The service supplier person comes to the place of the meter and notes down the reading at the top of each asking cycle. However, the ancient meter reading method not solely wastes labor human power but also acts as error-prone. The standard method is time overwhelming in addition. Another major drawback in this system is that the readings can't be taken if nobody is accessible at the house or wherever the matter is settled. The current system will not offer any scope for the user to conserve energy nor will it offer energy consumption predictions for close to the future that permits the user to act in a very additional planned manner. There square measure several such issues that cause inconvenience to the facility supplier as well as the shoppers. Even though the typical meters were replaced with additional economical electronic energy meters these issues persist [5].

There are smart-meter variants introduced around a decade back like Prepaid Water-meters, the same as pre-paid energy-meters. These meters are fundamentally Water-meters with an ON/OFF Solenoid Valve and Electronic module that records consumption. These are stand-alone units usually at remote locations catering to the facility to domestic or public taps. Just in case of personal consumption, the prepaid value is stored into the Meter memory till exhausted when the Valve gets closed. For public taps, the Prepaid Card is required to be inserted into the Reader and a pre-selected volume is dispensed. The worth for volume dispensed is reduced from the respective Pre-Paid Card used [6].

A variant of meter reading based on SMS messaging over GSM has been attempted especially for bulk water meters.

Among the varied implementations of Automated Meter Reading System the foremost modules that make difference are the Automated Meter Reading Module so the communication Module. The following systems consider the GSM Network for Communication purposes. GSM network provides worldwide coverage across countries thus enabling communication to each nook and corner without the necessity to implement a fresh

communication infrastructure solely for this purpose. Except for seamless coverage the GSM technology also provides services like SMS (Short Message Service) and GPRS (General Packet Radio Service) for requesting and retrieving reading from individual houses back to the energy provider wirelessly. Moreover, the GSM network may be a more efficient, reliable, and secure communication standard that's being widely used for over several years now without any technical issues. The low cost, simple setup, wide operating distance, less human intervention in form of the other salient features of this GSM-based system.

III. LITERATURE REVIEW.

Survey on conventional water meter:

The orthodox water metering has a propensity of being unreliable, inaccurate, and a matter of concern among customers, and hence it is considered to be one major reason why water service providers perform poorly and have very low revenue collection figures. The result of this poor performance coils into ineffective maintenance, inaccurate billing, and high non-revenue water. This conventional water meter requires manly labor for printing cheques/bills of each house in every locality. This task is tedious and as a matter of fact, it is non-profitable. One cannot keep the track of water usage through the existing water meter which eventually leads to wastage of water. We can overcome these challenges by using an apt water metering system.

Benefits of apt water meter:

1. Ensure a safe and steady water supply.
2. Enable flexible billing cycle Fight Non-Revenue Water with data monitoring.
3. By using a feedback mechanism with the help of smart water meter sensors the metering system becomes more reliable.
4. Save money by saving on unnecessary water distribution.
5. Eliminate the need for manual meter readings. Control Water Supply Remotely with IoT Valves with the help of communication sensors, we can track data on our phones by using an app and a database.
6. For live monitoring, LCD is used which displays the flow rate and usage continuously. Get a Bird-eye view of Water Consumption.
7. The efficiency of smart meters does not depreciate with time.

IV. BLOCK DIAGRAM.

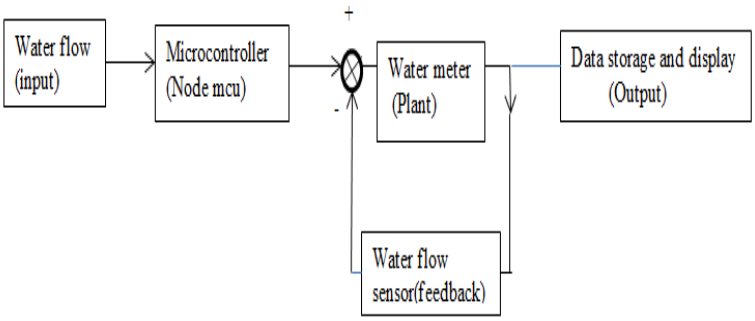


Fig. 1

1. Water flow acts as input to this System.
2. Microcontroller plays the role of both controller and actuator.
3. The plant is the water meter on which the tests/experiment is happening.
4. The output here is the flow rate and volume which is displayed on water wasted /consumed displayed on LCD and also the data is collected in the web database (Things speak).
5. The feedback here is the water flow sensor which tells us at what rate the water is flowing so that we can control the pace of water at which it flows by varying the top position.

V. APT WATER METER SYSTEM.

The proposed Apt water meter system comprises of hardware component called a water flow sensor. The flow sensor is the Position sensor. These are concerned with the determination of the position of some object concerning some reference point. The water flow sensor works on the principle of Hall Effect Sensor. By the principle of the Hall Effect, the voltage can be measured by the current path in this case flow rate/volume can be measured by the water path.

The water flow sensor consists of a plastic valve from which water can pass and a rotor along with the Hall Effect sensor when water flows through the valve it rotates the rotor. By this, the change can be observed in the speed of the motor. This change is calculated as output as a pulse signal by the Hall Effect sensor. Thus, the rate of flow of water can be measured and display on the LCD.

In this flow meter, for every liter of water passing through it per minute, it outputs about 4.5 pulses Calculate the flow rate in liters per hour (L/hr) using a simple conversion formula

Water flow rate is,

$$Q=VxA,$$

Where,

Q is flow rate/total flow of water through the pipe,

V is the average velocity of the flow and

A is the cross-sectional area of the pipe

Pulse frequency (Hz) = 4.5Q, Q is the flow rate in Liters/minute

Flow Rate (Liters/hour) = (Pulse frequency x 60min) / 4.5Q

VI. PROPOSED METHODOLOGY.

In this paper, we proposed the solution for water utilization using a water flow sensor and interface with Node MCU microcontroller which is embedded with Arduino code. Arduino software is used for Arduino coding to find the flow rate of water, volume consumption displays the output in LCD, and send the sensed data to the Things Speak server which can be monitored by customers.

Hardware needed:

1. **Node MCU microcontroller**

Node MCU has 10-bit ADC which means it scales an analog signal in a range of 0-1023. It has an inbuilt serial monitor that allows taking serial input and output from the Node MCU, while Node MCU is in action. It has inbuilt Wi-Fi. So that we can easily send sensed data through the Wi-Fi module. Node MCU is cost-effective.

2. **Water Flow Sensor**

A water flow sensor is used to take a note of how much water has been transferred from one area to the other. It consists of a plastic valve body, a water rotor, and a Hall Effect sensor.

3. **LCD 16*2 DISPLAY:**

16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. The LCD 16×2 working principle is, it blocks the light rather than dissipate [7].

Microcontroller connection with flow sensor:

Only three wires are coming from the flow rate sensor the 3V Vcc (Red wire), the GND (Black wire), and the signal/pulse (Usually yellow) line. Connect the Vcc and GND of the flow meter to the node MCU Vcc and GND. The signal/pulse wire is given to anyone digital input of Node MCU to show the digital output on the serial monitor.

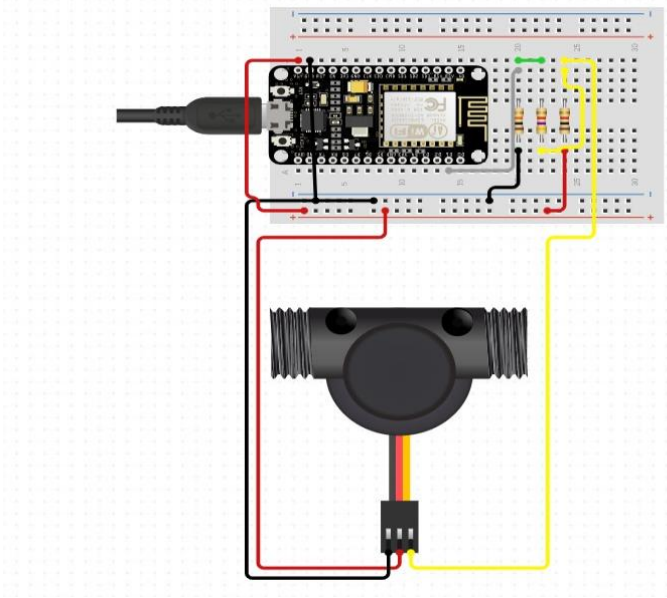


Fig .2

Microcontroller connection with LCD:

Connect contrast adjustment pin(Vo) to potentiometer's signal, Date pins to Node MCU's pins, Enable pin to one of the node MCU's pin, Cathode of LCD backlight to GND, Register select of the LCD to one of the Node MCU's pin, Read/Write pin to GND.

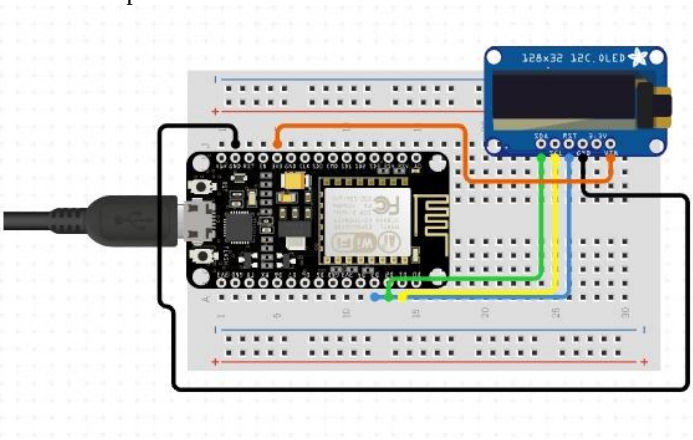


Fig.3

Integrated circuit diagram:

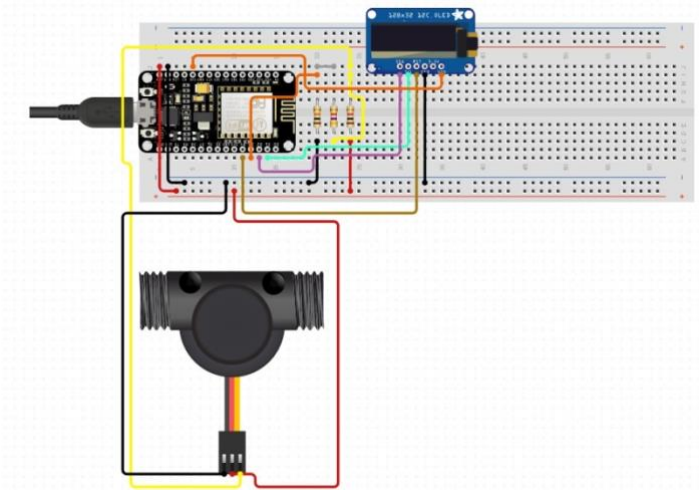


Fig.4

Setting up the webserver:

The Things Speak server was used in this project to display the amount of water consumed and the flow rate of water. Things Speak provides instant visualizations of data sent from the hardware (Node MCU). The data stored in the Thing speak Database can be retrieved as an excel sheet or using HTTP calls and the REST API and MQTT protocols via LAN or over the internet. It is convenient as the data stored is analyzed, and aggregated, and visualized through graphs [8].

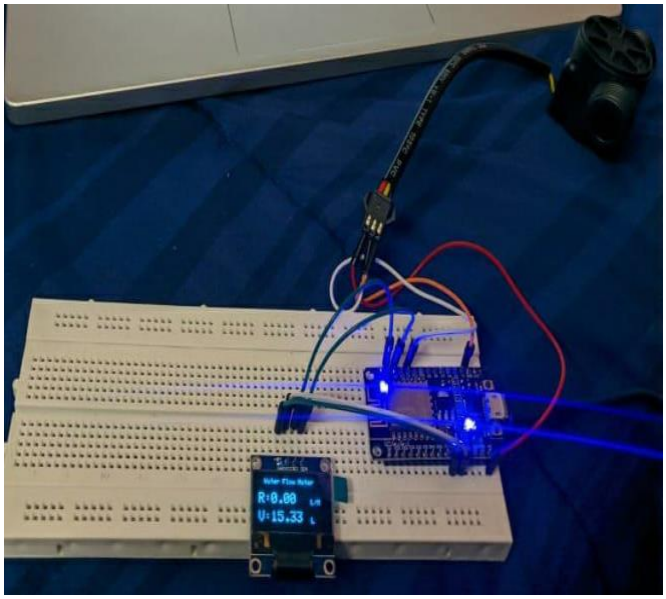
VII. WORKING PROCEDURE.

1. The integrated hardware is connected to the water pipeline. To be precise, the pipes are connected to the flow sensor on either of the sides as shown in Fig (4). The water spontaneously flows through pipes and the water flow sensor.

2. Water flow sensor consists of a plastic valve from which water can pass and a rotor along with the Hall Effect sensor. When the water flows through the valve it rotates the rotor. By this, the change can be observed in the speed of the motor. This change is calculated as output as a pulse signal by the Hall Effect sensor. This, the calculated rate of flow of water and volume of water consumed is displayed on the 16x2 LCD.

3. With the help of a Wi-Fi client/microcontroller (Node MCU) the data from the hardware can be sent to the preset Things Speak server by linking the Things Speak API key to the Node MCU in Arduino code.

4. The data i.e. flow rate of water and volume consumed can be viewed in the server in graphical representation as well as the conventional digital system as shown in the Fig.5



Fig,5

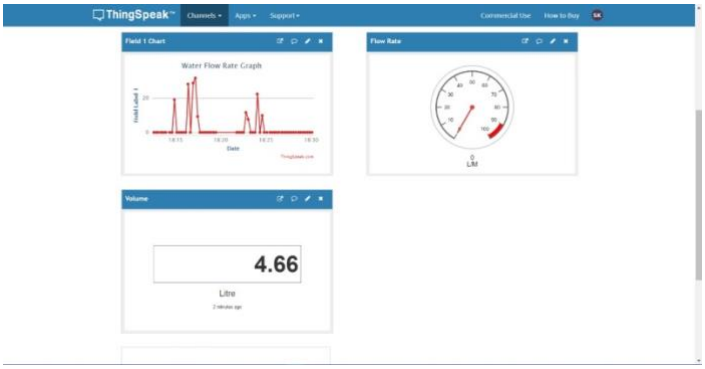


Fig.6

Flowchart of working procedure:

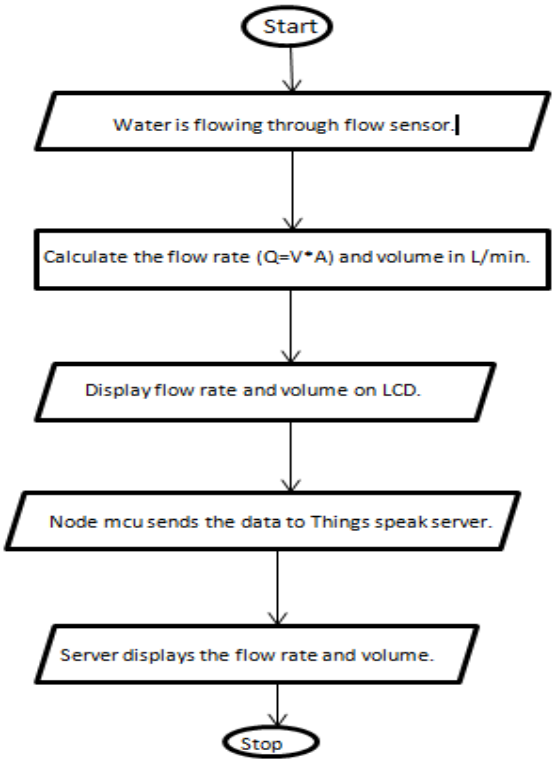


Fig.7

VIII. CONCLUSION.

An apt water meter based on IoT and a database for keeping track of the flow of water is discussed. The benefits of the prototype system are discussed. The novel approach overcomes disadvantages in conventional water-meter systems such as tampering in pre-paid water-meters that often go undetected due to the standalone nature of pre-paid meters; and many other drawbacks as discussed. The proposed architecture also helps in the economy by decreasing labor work.

The apt water meter is more reliable and feasible than the conventional water meter since the apt water meter eradicates water issues faced by both government and the customers.

REFERENCES:

[1]http://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014WR016869

[2]M Suresh1*, U. Muthukumar2, Jacob Chandapillai2,1Data Acquisition Systems Laboratory, 2Centre for Water Management Fluid Control Research Institute.

[3] https://www.irjet.net/archives/V5/i4/IRJET-V5I4221.pdf

[4] https://www.ceinsys.com/blog/influential-effects-automated-metering-infrastructure-making-powerful-smart-energy-management-system/

[5]https://www.researchgate.net/publication/276128988_Automated_Meter_Reading_System_-_A_Study

[6] Nayan Gupta and Deepali Shukla, "Design of Embedded based automated meter reading system for real-time processing".

[7] https://www.irjet.net/archives/V5/i4/IRJET-V5I4221.pdf

[8] https://thingspeak.com/pages/commercial_learn_more