DOI: http://dx.doi.org/10.26483/ijarcs.v10i2.6387

ISSN No. 0976-5697

Volume 10, No. 2, March-April 2019

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

AUTOMATED WATER METERING SYSTEM

Manav Mehta
Information Technology
Shah and Anchor Kutchhi Engineering College Mumbai, India

Archana Chaugule
Information Technology
Shah and Anchor Kutchhi Engineering College Mumbai, India

Rohit Misra
Information Technology
Shah and Anchor Kutchhi Engineering College Mumbai, India

Jahanvi Gupta
Information Technology
Shah and Anchor Kutchhi Engineering College Mumbai, India

Abstract: Nowadays, water scarcity and excess water wastage pose a serious threat to the Indian Population. A major reason for this is the improper, tedious and inconvenient methods of monitoring its usage. Methods used currently not only require a fair amount of manual labour but also has a high scope of errors and negligence. These methods are not feasible and valid for a growing economy. A feasible solution to this problem could be the provision of real-time monitoring, wherein a consumer can monitor their usage in real-time and take necessary steps to prevent said wastage. IoT water meters can help in such a scenario. Using automated monitoring through IoT we can enable a User/Consumer to monitor their water usage and consumption in real time and be mindful of it. This Paper introduces an Automated Water Metering System using Arduino which monitors water usage in real time and can create a consumer profile in two ways viz Prepaid and Postpaid. Using these profile s, we can further generate bill for the user based on their usage. This user data is stored on the cloud and with the help of an online dashboard can be accessed at anytime from anywhere. This system will use the existing Global System for Mobile Communication (GSM) for sending data to the cloud.

Keywords: Internet of Things, Arduino, Water Meter, GSM.

I. INTRODUCTION

The existing manual method for Water Meter Reading involves an assigned individual who visits every house, complex or society (residential or commercial) and manually make a record of their meter readings. These records are then forwarded to the local branch office and based on these records a bill is generated which is then forwarded to the respective heads of the society or complex (eg. A building Secretary in a housing society). This whole process requires a lot of time, effort and manpower with drawbacks such as human error in recording the readings, incorrect information by a corrupt individual, inability to detect illegal connections and water theft, etc. All these factors make the current billing system inaccurate and inefficient. Another drawback of this system is the fact that since the bill generated is in the name of the entire society or complex, many individuals stand to be overcharged or undercharged based on their consumption (i.e. an individual who lives alone and consumes less water will be charged as much as a family of 4-5 individuals who consume comparatively more water).

The recent advancements in the field of communication and information transfer has made information exchange fast, reliable and secure. This advancement along with the reduced cost in electronic and telecommunication devices in turn has given rise to low cost computing and communication devices like Arduino and GSM Communication. Computing devices like Arduino and GSM Sensors are now openly available throughout the world.

We aim to create an Automated Water Metering system using Arduino Uno which enables the user to track the water consumption in real-time using an online dashboard, select whether he wants a Prepaid or Post-paid connection and an automatically generated bill is sent to the user as the end of the billing cycle. If the bill is not paid within an aforementioned time period the water connection is shut off automatically.

Components Used

Arduino Uno: Arduino Uno is an Open Source microcontroller board based on the ATmega328P microcontroller. It consists of:

1. 14 digital input/output pins (of which 6 can be used as PWM outputs).
2. 6 analog inputs.
3. 16 MHz quartz crystal.
4. USB connection (USB A to B).
5. A Power Jack.
6. And a RESET button.

It can be powered with a USB cable or power it with an AC- DC adapter or battery to get started. It can accept 7V-20V power supply and can operate on a maximum voltage of 5V. It is a small, cheap and education-oriented board which can be used for small IoT systems such as this one.

GPRS SIM800L: The SIM800L module supports quad-band GSM/GPRS (General Packet Radio Service) network for connecting to the internet with HTTP and SMS message data remote transmission. The module also has built in TCP/IP stack that can be easily accessed via AT commands. This comes in handy for persistent data logging on low bandwidth networks required in this project. The SIM800L communicates with the microcontroller via UART port, supports command including 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands. The SIM800L supports quad-band frequencies 850/900/1800/1900MHz.

Flow Sensor: The Water Flow Sensor is an instrument that uses Hall effect to measure linear, nonlinear, mass or volumetric flow rate of a liquid or a gas. The flow sensor consists of a plastic valve body, a rotor, and a hall-effect sensor. When water or gas flows through the rotor, the rotor rotates, the speed of the rotor changes with different rate of flow. The hall-effect sensor records these rotations as pulses and according to the pulses outputs the amount of water or gas flowing through the sensor. It operates on a maximum working voltage of 5V and minimum of 4.5V.

Solenoid Valve: A Solenoid Valve is an electrically operated valve with one inlet port and one outlet port and a central core which consists of a core spring holding a valve seal. The valve seal prevents the flow of fluid or gas through the valve in the de-energized condition. When a strong flow of water passes through the valve its pressure pushes the seal upwards and enables the passage of water. In the energized state the core spring pulls up the valve seal and opens the valve for regular fluid flow. The Solenoid Valve operates on 12V. Since the Arduino UNO is unable to provide 12V of charge, to keep it powered we attach a Motor Driver circuit ( ) along with it to provide it with the desired voltage.

DS3231 Precision RTC Breakout: It has a coin cell plugged into the back, you can get years of precision timekeeping, even when main power is lost. It is used for time stamping the data sent to the server in case of a power outage or power failure.

16x2 LCD: The 16x2 LCD is a very basic electronic display module. It has 16 characters per line and there are 2 such lines. Each character is displayed in a 5x7 pixel matrix. This module has 2 registers viz Command and Data. The command register stores the command instructions given to the LCD and the data register stores the data to be displayed.

II. RELATED WORK

The proposed system uses data sent to the cloud by the SIM in the Water Meter to give the user a real-time reading of the meter. The cost of the messages sent is to be paid for by the consumer. The system makes use of a web-based dashboard to display the data to the user, in case the user has no internet connection then they cannot the access the data.

Problem Formulations:

Implementing this system can give rise to some new problems and challenges which are mentioned below:

- **Expensive:** Even when the cost of telecommunication services and computers have gone this Automated Water Meter will still cost more than an existing manual water meter, additionally the user will bear the cost of the messages sent by the IoT sim.
- **Time Consuming:** It will take time to train the current employees to understand and get used to the new system. They need to be trained to troubleshoot and repaid this system which is a lot more advances than an existing water meter.

Proposed System:

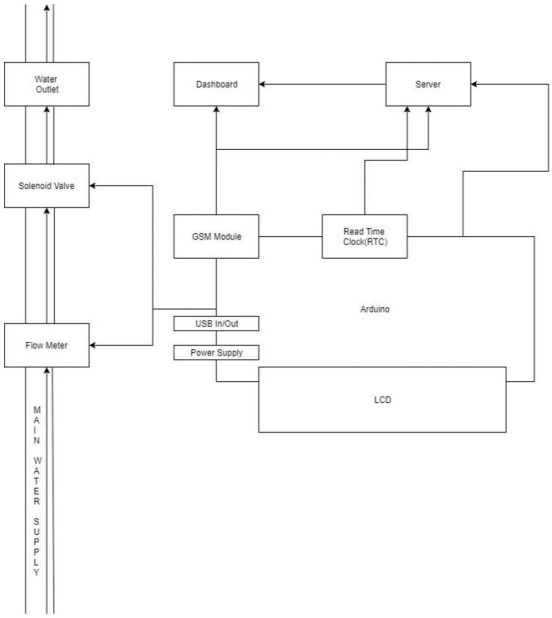

Fig: Block Diagram of the System

This is the block diagram of the system. The components in use are: Arduino Uno, GSM SIM 800L, Solenoid Valve, Flow Sensor, Real Time Clock, Server and a Dashboard. The programming language for Arduino Uno is C. The dashboard will be made using web technologies and the server is programmed using SQL.

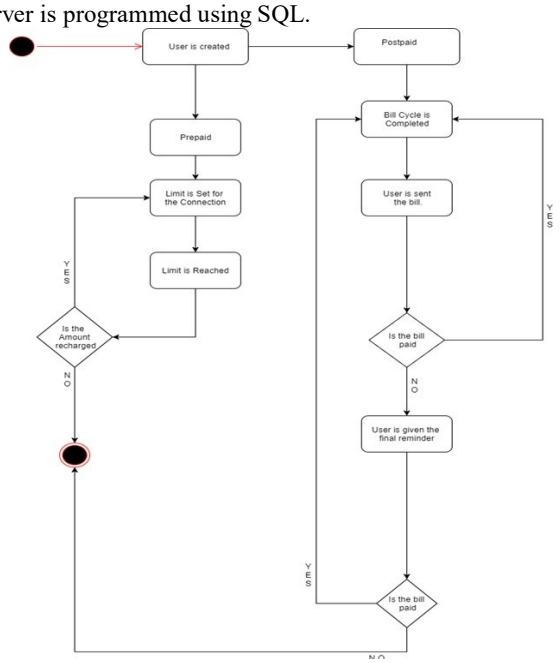

Fig: Flow Chart of the System

The proposed method is to use an IoT system to automate most of the water metering and billing system. In this

method an Automated Water Meter is attached to each individual residence for every user and each user has his/her unique id which is saved in the database. The water flow to the user's residence is recorded by the flow meter. The water meter has an IoT sim card which sends the usage data to the server. There are two types of connections in this system, prepaid and post-paid.

- **Prepaid System:**
  - The Customer will pay a predefined amount and the system supplies the allocated unit details to meter.
  - This data will get stored in its flash memory.
  - While consuming water the system will match the allowed amount with the unit details in flash.
  - As reading gets zero, system notifies the server and stops the water supply remotely via the Solenoid Valve.

- **Post-paid System:**
  - System will allow user to consume water and at the same time meter sends consumption details to server via GPRS.
  - After every bill cycle, the bill amount of the user is generated using pre-decided rates per litre of water consumed. This bill is then sent to the user with a due date within which the user is expected to pay the bill.
  - If the user fails to pay the bill amount within the specified time then the water supply is restricted to them until the dues are cleared.

The plan of action for the system is of two parts:

- **Water Flow-Rate Monitoring:**
  - The water flow rate will be monitored to track the amount of water used by the user.
  - This will help the user track their water consumption and make necessary adjustments as required in case of too much usage.
  - This will also help in maintaining a record of consumption of the user so the user is billed accordingly and the user can see his usage over time.
  - This will also help in preventing wastage of water and aid in proper management of water consumption.
  - This will also help in preventing unfair payment of bills by users who consume less but are required to pay more due to a combined bill for the society.

- **Water Flow Control:**
  - The water flow will be controlled remotely using GSM.
  - This will help the water suppliers control the supply of water to their users.
  - Since the supply will be billed according to the usage, this will help suppliers disconnect supply to users whose water quota is exhausted or have defaulted on their bill payments.

Advantages of our proposed system:

- **Live Monitoring:** As the user can monitor the system in real-time, any error in the live reading can be spotted immediately and be bought to the company's attention, thus reducing response time.

- **Fair Charges:** Since the system generates charges and bills based off of user consumption, it eliminates the possibility of a user being overcharged or undercharged based on someone else's consumption.

- **Reduced Time and Effort:** The system uses sensors to monitor flow, amount of water consumed and formulates a bill accordingly. This reduces the manpower required for these tasks, thus reducing time and efforts required.

- **Reduced chances of error and mismanagement:** This system makes use of electronically generated values and data to calculate user consumption. This reduces the chances of error in meter reading and the consumer being wrongly charged. This system also eliminates the possibility of purposeful error in meter reading by a corrupt official.

- **Reduced Wastage of Water:** This proposed system allows a consumer to monitor their water usage in real time. This provides the user an opportunity to view and plan their consumption and accordingly take measures to reduce wastage of water.

III. FUTURE SCOPE

- **TDS Monitoring*:*** A TDS sensor can be added to the system to monitor the purity of the water and look for any substances that may be present. This can also be monitored in real-time by the user.

- **Payment Portal:** A payment portal can be added to the dashboard where the user can pay the bill amount instantly, this makes the payment process more streamlined and efficient.

- **Leak Detection:** In this case a flow sensor can be attached to both ends of the pipeline supplying the water to the premises, both the flow sensors should have the same amount of water flowing at a given time and any variance will mean a leak is present or theft of the water. Since the flow is also monitored in real-time it can allow the leak detection at the earliest.

IV. CONCLUSION

This proposed system makes use of IoT technology for real-time water consumption monitoring. It provides real-time monitoring of usage through the online dashboard has two connection types i.e. prepaid and postpaid. It is designed for automatic meter reading and sending the data to the central server using GPRS connection. The system can immediately cut the connection in case of non-payment of bill. This system removes the human element in water meter reading. This system can greatly increase customer satisfaction and contribute to reduction in wastage in water consumption.

V. REFERENCES

[1] Design of a water flow and usage meter: S Botha, LA Meijsen, GP Hancke and BJ Silva Department of Electrical, Electronic and Computer Engineering University of Pretoria Pretoria, South Africa.

[2] A Novel Smart Water-Meter based on IoT and Smartphone App for City Distribution Management: M Suresh1*, U. Muthukumar2, Jacob Chandapillai2 1Data Acquisition Systems Laboratory, 2Centre for Water Management Fluid

Control Research Institute, Palakkad, Kerala. 678 623. India.

[3] Design and Development of Automated Water Distribution and Metering System for Residential Buildings: Eswaran.P1, Aswin Kumar2 Department of Electronics and Communication Engineering, SRM University Kancheepuram Dt., Tamilnadu, 603203, India.

[4] Design and Development of SoC Based Residential Water Meter Monitoring System: V. Gokilapriya1 and P.T.V. Bhuvaneswari2 Department of Electronics Engineering, Madras Institute of Technology, Anna University, Chennai, India.

[5] An Intelligent SMS-Based Remote Water Metering System: Nusrat Sharmin Islam and Md. Wasi-ur- Rahman Department of Compuper Science & Engineering, Bangladesh University of Engineering & Technology, Dhaka-IOOO, Bangladesh.

[6] Smart Water Meter System for User-Centric Consumption Measurement: Mduduzi John Mudumbe and Adnan M. Abu-Mahfouz Advanced Sensor Networks Research Group Meraka Institute, Council for Scientific and Industrial Research (CSIR) Pretoria, South Africa.

[7] Smart metering implementation for enabling Water Conservation and Water Demand Management: Obby A. Masia, Louwrence D. Erasmus, SMIEEE Department of Engineering and Technology Management GSTM, University of Pretoria Pretoria, South Africa.