

# Prepaid Water Meter and Quality Check

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**Abstract** The Prepaid Water Meter System is an automated water management solution developed to ensure efficient utilization of water resources and accurate billing through advance payment. The system integrates a water flow sensor and an Arduino microcontroller to measure real-time water consumption and manage water supply based on a prepaid credit mechanism. A solenoid valve is used to electronically regulate water flow according to the available balance. The main objective of this system is to eliminate manual meter reading, prevent unpaid water usage, and promote responsible water consumption. The water flow sensor continuously measures the quantity of water consumed, while the Arduino processes this data and deducts it from the prepaid credit stored in the system. When the credit is fully consumed, the solenoid valve is automatically closed to stop water supply, ensuring strict adherence to prepaid usage. The proposed system offers a low-cost, reliable, and scalable solution suitable for residential buildings, hostels, apartments, and institutional water supply systems. By introducing automation and prepaid billing, the system reduces water wastage, improves revenue collection, and enhances transparency in water distribution.

**Keywords:** Prepaid Water Meter, Arduino, Water Flow Sensor, Solenoid Valve, Embedded System, Smart Water Management

## I. INTRODUCTION

Water plays a vital role in domestic, industrial, and agricultural activities. With rapid population growth and urbanization, the demand for clean and safe water has increased significantly. However, inefficient water management systems and conventional billing practices have resulted in excessive water wastage and financial losses for water supply authorities. Traditional water metering systems operate on a postpaid basis, where consumers use water first and pay later. Delayed billing and unpaid water usage further increase operational challenges. Prepaid water metering systems provide a modern approach to water management by requiring users to pay in advance for water consumption. This approach ensures fair billing, encourages users to monitor and control their consumption, and eliminates the problem of unpaid bills. The availability of low-cost microcontrollers such as Arduino has made it possible to design reliable prepaid water meters that are easy to deploy and maintain. This project focuses on the design and implementation of a prepaid water meter system using Arduino that enables real-time monitoring of water usage and automatic control of water supply.

## II. LITERATURE REVIEW

Paper Name	Author Name	Year	Algorithm / Logic Used	Database	Observation	Drawbacks
Design of GSM-Based Smart Prepaid Water Meter	B. Ntambara, D. Nyambo	2023	Credit-based control logic	MySQL	System enables prepaid water usage with automatic cutoff when credit is exhausted, improving billing accuracy and reducing water wastage.	GSM dependency increases cost and power consumption.

IoT-Based Prepaid Water Metering System	S. Patil, R. Kulkarni	2022	Thresholdbased deduction	Firebase	Real-time monitoring and prepaid billing improve transparency and user awareness of water consumption.	Internet dependency and higher implementation cost.
Smart Water Meter Using Embedded System	A. Sharma, P. Verma	2021	Pulse-count algorithm	SQLite	Flow sensor pulses are used to calculate accurate water usage with automated billing.	No remote monitoring or alert mechanism.
Prepaid Water Meter with Automatic Control	K. Rao, M. Singh	2020	Credit decrement logic	MySQL	Prepaid system prevents unpaid water usage and ensures fair distribution of water resources.	Manual recharge process limits usability.
Arduino-Based Prepaid Water Meter	R. Mehta, S. Joshi	2019	Rule-based control	—	Low-cost Arduino-based system effectively measures water flow and controls supply.	Limited scalability and no data storage.
Review of Smart and Prepaid Water Metering Systems	J. Smith, M. Anderson	2024	Comparative Study	—	Comprehensive review of smart and prepaid water metering techniques and technologies.	No experimental validation.

1. Design of GSM-Based Smart Prepaid Water Meter (2023) Authors: B. Ntambara, D. Nyambo. This paper presents a prepaid water metering system that uses GSM technology for communication. A credit-based control logic is implemented, where water supply is automatically cut off once the user's balance reaches zero. The system improves billing accuracy and helps reduce water wastage by encouraging responsible usage. However, the dependence on GSM increases both system cost and power consumption, making it less suitable for low-cost deployments.

2. IoT-Based Prepaid Water Metering System (2022) Authors: S. Patil, R. Kulkarni. The authors propose an IoT-based prepaid water metering system using threshold-based deduction logic. Water consumption data is stored and monitored in real time using a Firebase database. Users can track usage remotely, which increases transparency and awareness. The major limitation of this system is its dependency on internet connectivity and relatively high implementation cost.

3. Smart Water Meter Using Embedded System (2021) Authors: A. Sharma, P. Verma. This paper describes a

smart water meter based on an embedded system that uses a pulse-count algorithm. Water flow is measured by counting pulses generated by the flow sensor, and billing is automated using a local SQLite database. The system provides accurate measurement, but it lacks remote monitoring and alert features, limiting its functionality in modern smart environments.

4. Prepaid Water Meter with Automatic Control (2020) Authors: K. Rao, M. Singh. In this work, a prepaid water meter with automatic control is developed using credit decrement logic. The system ensures that water is supplied only when sufficient balance is available, preventing unpaid usage. Data is stored in a MySQL database. Although effective, the manual recharge process reduces user convenience and scalability.

5. Arduino-Based Prepaid Water Meter (2019) Authors: R. Mehta, S. Joshi. This paper focuses on a low-cost prepaid water meter developed using Arduino and rule-based control logic. The system measures water flow and controls supply efficiently, making it suitable for small-scale applications.

However, it lacks data storage, remote access, and scalability, limiting its use in large deployments.

6. Review of Smart and Prepaid Water Metering Systems (2024) Authors: J. Smith, M. Anderson. This paper provides a comparative review of various smart and prepaid water metering technologies. It analyzes different algorithms, communication methods, and system architectures. While the review offers a broad understanding of existing solutions, it lacks experimental implementation and validation, making it purely theoretical.

### III. EXISTING SYSTEM

The existing water supply system typically uses mechanical water meters and postpaid billing methods. Water consumption is measured using physical meters installed at consumer premises, and readings are collected manually at fixed intervals. In postpaid systems, water supply continues even if consumers delay or avoid payments. This results in financial losses and inefficient water usage. Additionally, manual meter reading can lead to errors, disputes, and delayed billing cycles. There is no real-time control over water usage, and consumers are often unaware of how much water they are consuming on a daily basis.

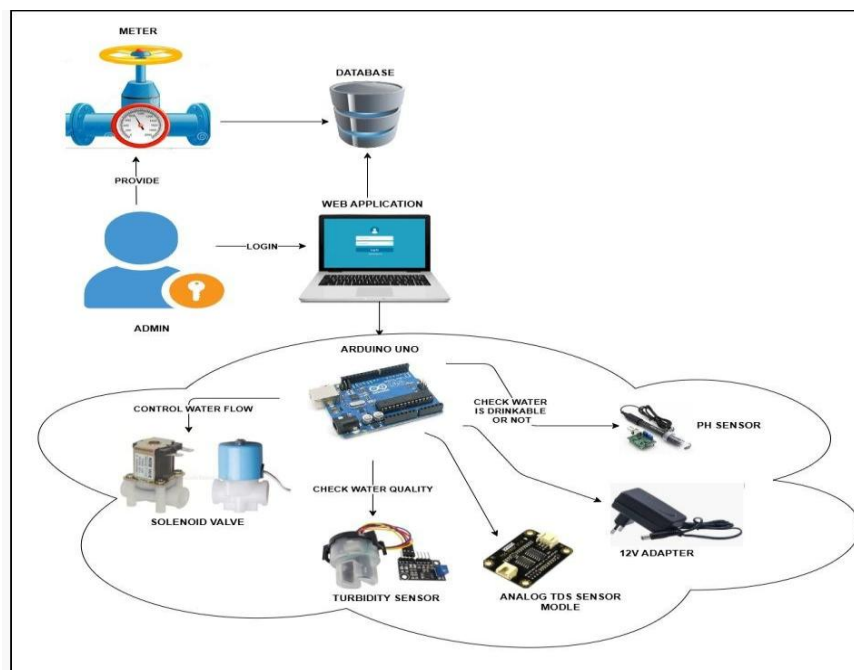
Limitations of Existing System:

- Manual meter reading
- Inaccurate and delayed billing
- Unpaid water consumption
- No real-time usage control
- Increased water wastage
- High operational and manpower cost

### IV. PROPOSED METHODOLOGY

The proposed Prepaid Water Meter System introduces automation and prepaid billing to overcome the limitations of traditional systems. The system ensures that water is supplied only when prepaid credit is available. A water flow sensor installed in the pipeline measures the water flow continuously. The Arduino microcontroller processes the sensor data and calculates the total water consumed. This consumption is deducted from the prepaid balance in real time. A solenoid valve controls the water supply based on the remaining balance. When the prepaid credit reaches zero, the solenoid valve automatically stops the water flow. After recharging the credit, the system resumes normal operation. The system follows a step-by-step methodology to ensure accurate measurement and reliable control of water usage.

1. Data Acquisition The water flow sensor generates pulses proportional to the rate of water flow through the pipe.
2. Signal Processing The Arduino microcontroller counts the pulses from the flow sensor and converts them into volume using calibration constants.
3. Credit Management The calculated water consumption is continuously subtracted from the prepaid credit stored in the system memory.
4. Control Mechanism The solenoid valve is controlled electronically to allow or restrict water flow based on the available credit.
5. Recharge Process Once the prepaid credit is reloaded, the system automatically allows water flow and resumes operation.



System Architecture

### Advantages of Proposed System:

- Accurate real-time water measurement
- Automated prepaid billing
- Prevention of water wastage
- Elimination of manual meter reading
- Improved revenue management
- Simple and cost-effective implementation

### V. CONCLUSION

The Prepaid Water Meter System using Arduino provides a practical and effective solution for modern water management challenges. By implementing prepaid billing and automated water supply control, the system ensures fair usage, reduces water wastage, and improves revenue collection.

The system's simplicity, reliability, and affordability make it suitable for residential, commercial, and institutional environments. It demonstrates how embedded systems can be effectively used to promote sustainable water usage and efficient resource management. Future enhancements may include wireless communication, mobile-based recharging, and data analytics for consumption analysis.

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