Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

CSE-4264 Internet of Things Lab

RFID-Enabled Smart Water Dispensing System with Card Control and Live Billing Usage Tracking
Group : 04

Submitted by

1. Sadman Salman Saad 20210104114
2. Abdullah Al Maruf 20210104116
3. Sharun Tawsif 20210104124
4. Nafisa Tabassum Shouty 20210104127

Submitted To:

Mr. Mustofa Ahmed & Ms.Nusrat Jahan

Submission Date : 09/07/2025

Contents

1 Introduction

Access to clean and fairly distributed water is an essential need for every community, but public water systems often struggle with waste, inefficiency, and a lack of accountability. Traditional manual methods can't ensure that resources are used responsibly, and billing mistakes are common. With the rise of affordable IoT technology, there is now an opportunity to automate, monitor, and optimize public water management for the benefit of all users. This report details the design and features of an RFID-enabled smart water dispenser that leverages IoT to deliver secure access, real-time tracking, accurate billing, and transparent record-keeping for fair and efficient public water use.

2 Problem Statement

Effective and equitable management of public water resources is a critical challenge in many communities. The current landscape presents several key problems:

1. **Uncontrolled Water Usage:** Public water points often lack controls to prevent excessive use, resulting in significant wastage—especially in water-scarce areas.

2. **Manual and Error-Prone Billing:** Manual billing is inefficient, prone to mistakes, and lacks transparency, which can cause disputes and unfair charges.

3. **Unauthorized Access and Unfair Usage:** Anyone can access public water sources without a secure authentication mechanism, leading to misuse and unequal distribution.

4. **Lack of Real-Time Tracking:** There is no reliable system to monitor individual usage and cost in real time, making accountability and anomaly detection impossible.

5. **Absence of Automation in Water Management:** Most systems rely on manual operation, which hinders efficiency and fails to support scalable or sustainable water management.

3 Project Description & Solution Approach

This project proposes an IoT-based smart water dispensing system that combines RFID-based user authentication, real-time monitoring, live billing, and cloud-based data logging. The system is designed for public places such as WASA points, campuses, schools, and community water stations.

How It Works:

1. Users authenticate themselves using RFID cards at the dispenser.
2. Only authenticated users can access water; water flows only while the RFID card is present.
3. ESP32 microcontroller controls all operations: authentication, pump activation, and billing.
4. Billing is calculated in real time (based on flow or duration) and displayed on an LCD screen.
5. Usage and billing data are automatically logged to Google Sheets via WiFi for transparency and remote monitoring.
6. The system includes manual ON/OFF switches for maintenance and emergencies.

4 Key Functionalities/Features

- **RFID-Based User Authentication:** Only registered users can access the dispenser.
- **Smart Water Dispensing:** Water flows only when an authorized card is present.
- **Real-Time Usage Monitoring:** System tracks the exact amount of water dispensed.
- **Live Billing Calculation:** Displays and logs cost based on water usage.
- **LCD Display Feedback:** Shows status, usage, and bill during operation.
- **Automated Data Logging:** Sends usage and billing data to Google Sheets.
- **Power Management:** Ensures efficient and safe operation of all components.
- **Manual ON/OFF Switch:** Allows for easy maintenance or emergency shutdown.

5 List of Required Equipment and Cost

Equipment	Quantity	Unit Price (BDT)	Total Price (BDT)
RDM6300 RFID Reader	1	250	250
125 kHz RFID Card	1	50	50
16x2 LCD Display	1	200	200
I2C LCD Driver	1	80	80
Water Pump (Mini DC)	1	180	180
Water Pipe (Flexible)	1 meter	40	40
Water Tank	1	300	300
Veroboard	1	60	60
Power Supply Adapter	1	150	150
Battery Case (4xAA)	1	60	60
PVC Board	1	100	100
MP1584 Buck Converter	1	120	120
Power Switch	1	20	20
Female Header Strip	1	30	30
Male Header Strip	1	30	30
1 Channel 5V Relay Module	1	90	90
Jumper Wire (M-M / M-F / F-F)	1 set	N/A	N/A

Table 1: Bill of Materials

ESP32 WiFi Development Board - Provided by Lab, not included in cost.

Total Cost (excluding lab-supplied items and jumper wires): BDT 1,730

6 System Diagram

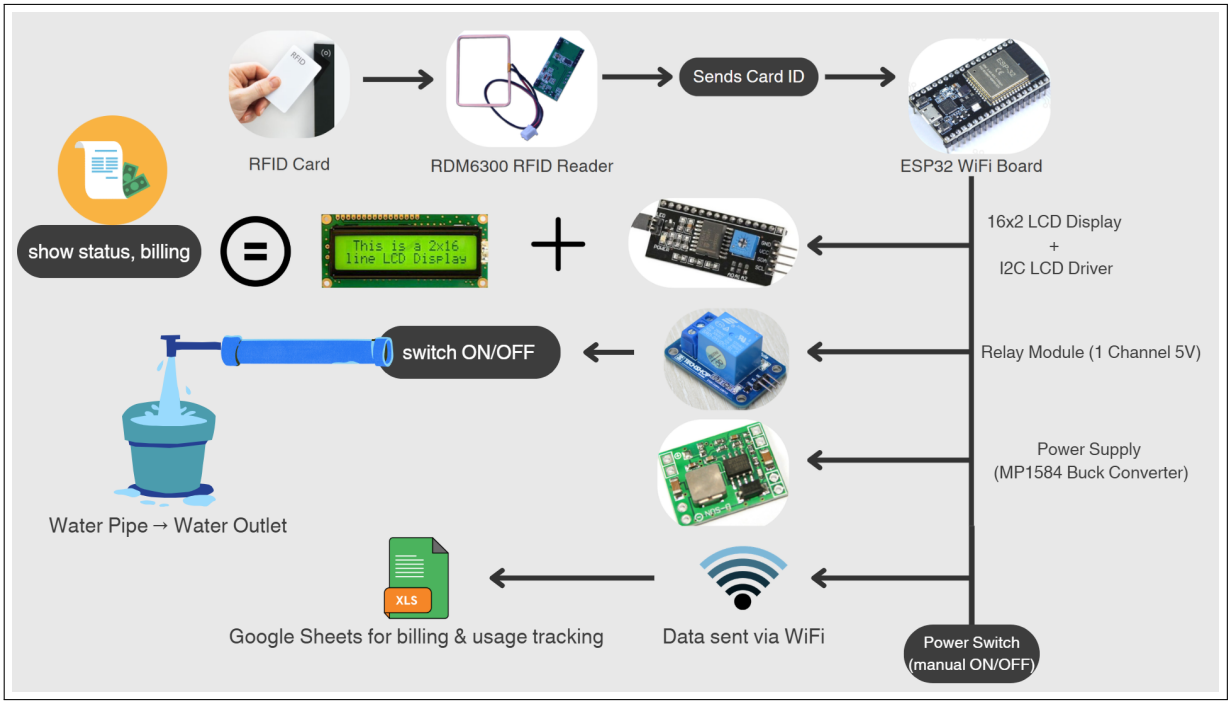

Figure 1: System Diagram of the RFID-Enabled Smart Water Dispensing System

7 Flowchart

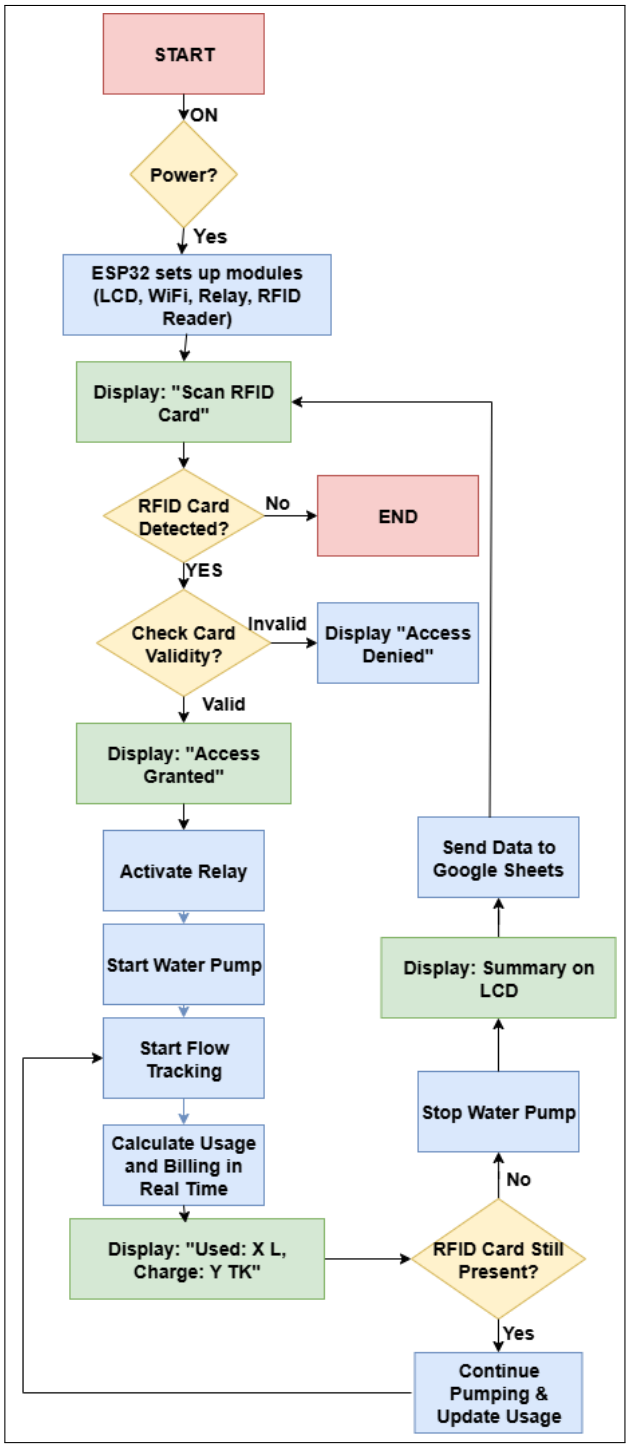

Figure 2: System Architecture of RFID-Enabled Smart Water Dispensing System

8 Literature Review

Smart water dispensing systems are evolving toward automation, accountability, and real-time data tracking. Various prototypes and research efforts have attempted to integrate RFID, microcontrollers, flow sensors, and cloud connectivity. Below is an analysis of existing systems:

[**1**] Instructables' IoT project demonstrates a basic water dispensing system using ESP8266 and RFID to control a pump and log usage via Blynk. It is DIY-friendly but lacks secure logging or billing mechanisms and doesn't support cloud-based real-time tracking.

[**2**] The Smart Water ATM system by Abubakar et al. introduces RFID-based user authentication and flow-based metering using Arduino. While it offers real-time billing on an LCD, it misses cloud integration and scalable database handling.

[**3**] Ahmed's study focuses on vending control with added GSM-based SMS alerts using RFID and ultrasonic sensors. Though combining hardware modules innovatively, it lacks real-time usage billing or online payment mechanisms.

[**4**] Kumari and Sinha propose a low-cost rural water management system using RFID and LCD display. This system is effective for offline rural use but lacks billing, usage analysis, or cloud data sync.

[**5**] Jaiswal and Jaiswal present an RFID-controlled dispensing system that can detect container placement. Its offline architecture limits usage analytics, and it doesn't offer cloud tracking or detailed consumption logs.

[**6**] Labrahmi's GitHub-based project offers an open-source ESP32 solution with RFID access and relay control. While modular in design, it does not integrate with databases like Firebase or Google Sheets for user tracking or billing.

[**7**] Jain et al. provide an IoT water dispensing setup based on flow time rather than volume sensors. The system is simple and reliable but lacks RFID-user linkage or internet backup for logs.

[**8**] Singh builds a liquid dispensing machine with fixed volume output using solenoid valves and RFID. It lacks real-time usage adaptation, billing customization, and does not upload data online.

[**9**] Patel et al. design an Arduino-based system that dispenses predefined quantities of water per RFID scan. This is suitable for communities but does not support real-time cloud logging or adaptive billing models.

[**10**] Deshmukh and Joshi introduce monitoring with data analytics using Wi-Fi and ultrasonic sensors. Their system is good at monitoring but lacks user-specific billing tied to RFID authentication.

9 Gap Analysis

Despite advancements in IoT water management, existing systems often lack real-time billing, secure RFID authentication, cloud integration, and user-specific usage tracking. This project addresses all these gaps by providing a complete, automated solution with real-time data, transparent billing, and cloud-based monitoring, making it suitable for both urban and rural public water distribution.

10 Conclusion

The RFID-enabled smart water dispensing system presents a comprehensive, practical, and sustainable approach to managing public water distribution. By integrating IoT, automation, and real-time billing, it enhances transparency, prevents wastage, and ensures fair distribution—paving the way for responsible and scalable water management.

11 References

[1] Instructables Team, "Water Dispenser IoT Project," *Instructables*, 2024. [Online]. Available: https://www.instructables.com/Water-Dispenser/

[2] K. Abubakar, M. Tariq, and S. R. Ali, "Smart Water ATM with Arduino Integration, RFID Authentication, and Dynamic Dispensing," *Electronics*, vol. 13, no. 9, p. 1657, 2024. [Online]. Available: https://www.mdpi.com/2079-9292/13/9/1657

[3] H. Ahmed, "Advancing Water Vending Industry through RFID and IoT Empowerment," *International Conference on Advanced Electrical and Electronics Engineering (ICAEEE)*, 2024. [Online]. Available: https://www.researchgate.net/publication/381693362

[4] P. Kumari and R. Sinha, "IoT Based Water Management System using RFID for Rural Areas," *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)*, vol. 4, no. 5, pp. 123–130, 2024. [Online]. Available: https://ijarsct.co.in/A16820.pdf

[5] N. Jaiswal and R. Jaiswal, "Smart Water Dispenser Using RFID Reader," *Project Report, Academia.edu*, 2023. [Online]. Available: https://www.academia.edu/42654070

[6] A. Labrahmi, "Arduino Smart Water Dispenser System," *GitHub Project Repository*, 2022. [Online]. Available: https://github.com/Labrahmi/water-dispenser-system

[7] S. Jain, M. Yadav, and D. Kumar, "Automatic Water Dispenser Using IoT," *International Journal of Creative Research Thoughts (IJCRT)*, vol. 12, no. 4, pp. 88–91, 2024. [Online]. Available: https://ijcrt.org/papers/IJCRT2431396.pdf

[8] V. K. Singh, "Design and Construction of a Smart Liquid Dispensing Machine," *International Journal of Advanced Research in Science and Technology (IJARST)*, vol. 9, no. 2, pp. 55–60, 2023. [Online]. Available: https://www.ijarst.in/public/uploads/paper/951851654145888.pdf

[9] A. Patel, R. Bhatt, and S. Shah, "Automatic Water Dispenser Using IoT," *International Journal of Innovative Research in Technology (IJIRT)*, vol. 11, no. 3, pp. 112–117, 2024. [Online]. Available: https://ijirt.org/published-papers/IJIRT164235_PAPER.pdf

[10] R. Deshmukh and P. Joshi, "Smart Water Dispenser Monitoring System," *International Conference Proceedings on Embedded and IoT Systems*, 2020.