Journal of Harbin Engineering University
ISSN: 1006-7043

Vol 46 No. 7
jULY 2025

Coin Operated Water ATM with Bottle Dispenser

Amina Kotwal, Shrivardhini Sakhare, Tohid Sanadi, Shripad Satpute and Adnan Sayyed

Assistant Professor, UG student, UG student, UG student, UG student

Department of Electronics and Telecommunication Engineering

Bharati Vidyapeeth College of Engineering,Navi Mumbai, Maharashtra, INDIA

Abstract

Introduction: The Coin Operated Water ATM with Bottle Dispenser is an innovative automated system designed to dispense water and bottles upon the insertion of coins. The system's primary components include a coin acceptor, water dispensing mechanism, bottle dispensing mechanism, and a user interface, all controlled by a Raspberry Pi.

Objectives: The coin acceptor validates and counts inserted coins, updating the user's balance in real-time. Upon reaching the required balance, the system activates the water pump and solenoid valve to dispense a predetermined amount of water while simultaneously releasing a single bottle from the dispenser. Integrated sensors monitor the water tank level and bottle availability, ensuring seamless operation and resource management. An LCD display provides real time information to the user, enhancing the overall user experience.

Methods: The proposed methodology uses power supply and control unit, coin acceptance and validation, water quality monitoring, dispensing mechanism, user interface display and water dispensing units. Raspberry-pi is used as the main control unit. Input sensors help to check the water quality, after coin acceptance, water is dispensed only if the water quality is of standard quality. User gets the option for dispensing bottle or water. Quantity of water is decided by coin value.

Results: This paper demonstrates the practical application of embedded systems and automation in addressing real-world challenges, offering a convenient and effective solution for dispensing clean drinking water.

Conclusions: The Coin Operated Water ATM with Bottle Dispenser is an innovative and practical solution to tackle the world- wide issue of ensuring safe potable water in disadvantaged regions. By leveraging automation and embedded systems, the project demonstrates how technology can simplify access to essential resources, reduce waste, and promote sustainability.

Keywords: water ATM, dispenser, IOT.

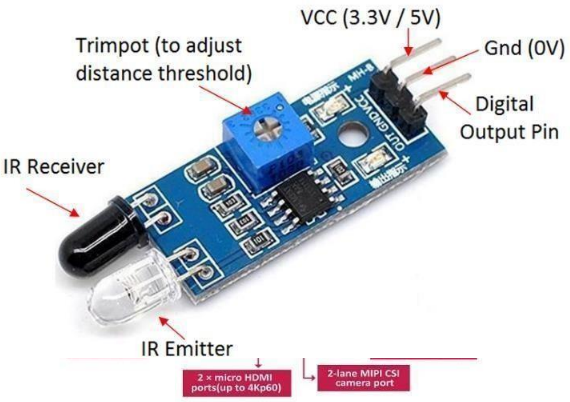
1. Introduction

Access to clean drinking water is a fundamental necessity, yet in many parts of the world, it remains a challenge due to limited resources or the absence of infrastructure. The Coin Operated Water ATM with Bottle Dispenser is an innovative solution designed to provide clean drinking water in a convenient, automated manner. By integrating advanced technologies such as coin acceptors, sensors, and automated dispensing systems, this project aims to tackle the global challenge of providing accessible, affordable, and clean water to people in public areas, rural regions, and underserved communities.

The system operates on a simple pay-per-use model, where users insert coins to receive both a pre-measured amount of water and a bottle. The system is controlled by a Raspberry Pi, which manages all the components, including the coin acceptor, water and bottle dispensers, sensors, and the user interface. This setup ensures the system operates efficiently, requiring minimal human supervision. The project is not only a demonstration of the practical application of embedded systems but also showcases how automation can be employed to solve real-world challenges. By monitoring water levels and bottle availability, the system ensures uninterrupted service, and the coin validation process offers a transparent and fair method for accessing resources. This project introduces a sustainable, scalable, and user friendly solution to water distribution in areas where infrastructure or access to water is limited. It highlights the potential of integrating technology, automation, and resource management to improve the avail- ability of essential services like clean water

1.1 Parts of Coin Operated Water ATM with Bottle Dispenser

Raspberry Pi 4 :- The Raspberry Pi 4 Model B is a



versatile single-board computer widely utilized in electronics and IoT projects. It includes a 40-pin GPIO for external device connections, USB-C power input, dual-band Wi-Fi, Bluetooth 5.0, and Gigabit Ethernet for high-speed connectivity. Additionally, it features two USB 3.0 and two USB 2.0 ports, offering expanded peripheral support, dual micro HDMI outputs supporting 4K video, and ports for connecting cameras and displays. This versatile board supports a wide range of applications, including automation, multimedia, and DIY projects, making it an ideal controller for the Coin Operated Water ATM system.

Fig 1.1 Raspberry Pi 4

Coin Acceptor :- The coin acceptor is a crucial component in automated vending systems like the Coin Operated Water ATM. It identifies and verifies different denominations of coins, allowing the system to accept payments in exchange for water or water bottles. The coin acceptor is programmed to recognize specific coins (e.g., Rs. 2, Rs. 5, Rs. 10). and sends an electronic signal to the central controller (Raspberry Pi) when a valid coin is inserted. Its reliable operation ensures accurate and secure transactions, making it essential for user interaction and payment processing in the system.

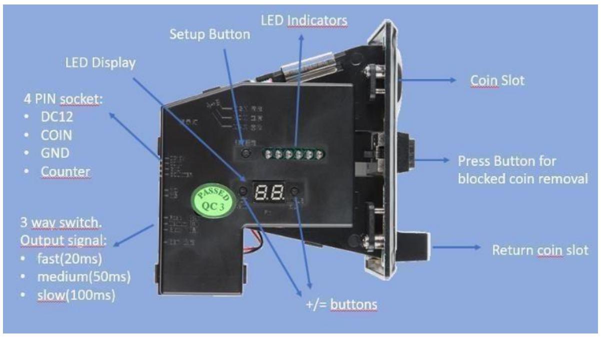


Fig 1.2 Coin Acceptor

IR Sensor :- The IR sensor (Infrared sensor) is used in the Coin Operated Water ATM to detect the presence of objects or monitor the water bottle's position.

Fig 1.3 IR sensor

It works by emitting infrared light and measuring the reflection to sense whether an object is in proximity. In this system, the IR sensor ensures that bottles are correctly positioned for dispensing or detects user interactions without physical contact. Its role enhances the system's efficiency and hygiene by enabling touch less operation and precise control of the dispensing mechanism.

2. Literature Review

A. Intelligent Water Level Monitoring System Using IoT, Sandhya Kulkarni, Vishal D Raikar, Rahul B K, Rakshitha L V, Sharanya K and Vandana Jha,2020

The document titled "Intelligent Water Level Monitoring System Using IoT" presents a system designed for efficient water management in domestic settings. The system utilizes IoT technology and depth sensors to monitor water levels. If the water level exceeds a set threshold (20 cm), the Arduino UNO triggers a GSM module to notify the user via a phone call. Additionally, a submersible water pump is activated to drain the excess water into a storage tank. This stored water can be reused for tasks such as gardening or domestic purposes, minimizing wastage. The proposed system incorporates several key components, including an Arduino UNO microcontroller, water level sensors, a submersible pump, and a GSM module. The water level sensors continuously monitor the water depth inside a tank or domestic area. If the water level exceeds the pre-set threshold value of 20 cm, the Arduino UNO activates the GSM module to notify the user via a phone call. In addition, the system activates a submersible pump that automatically transfers excess water into a storage tank. The collected water can be repurposed for tasks like watering plants or other household activities, effectively reducing waste. If the water level falls below the set threshold, the system remains in monitoring mode without initiating any action.

B. An IoT Based Smart Water Quality Monitoring System using Cloud, Ajith Jerom B, Manimegalai R, Llayaraja V, 2020

The paper titled "An IoT Based Smart Water Quality Monitoring System using Cloud" discusses the creation of a real-time water quality monitoring system utilizing Internet of Things (IoT) technologies. The authors emphasize the major environmental issue of water pollution in India, mainly resulting from untreated sewage, agricultural runoff, and unregulated industrial activity. Traditional water quality monitoring methods, which involve manual sample collection and laboratory analysis, are time consuming, labor-intensive, and unable to provide real-time results. To address these challenges, the paper proposes a smart water monitoring system utilizing IoT devices like NodeMCU, integrated with multiple sensors, evaluates water quality parameters, including pH, humidity, and pollutant detection. The system continuously collects water data, which is transmitted to the cloud using an in-built Wi-Fi module, and stored for further analysis with deep learning techniques. This approach provides a cost-effective solution for monitoring water quality in various water bodies, aiming to reduce environmental pollution and safeguard public health. The system consists of three primary components: live data retrieval, a connectivity module, and untethered sensors. The data retrieval process captures parameters from sensors placed in water bodies, while the communication interface enables real-time transmission of data to the cloud. Wireless sensor nodes, housed in a floating buoy system, continuously monitor water quality while minimizing power consumption through a sleep-wake cycle. The data stored in the cloud is processed using machine learning algorithms, which predict water quality and alert users when harmful levels of pollutants are detected. The system is designed to be scalable, allowing deployment in diverse environments like rivers, lakes, and ponds, and can help mitigate the effects of environmental pollution, especially in rural areas where awareness of water contamination is low.

c. IoT Enabled Smart Water ATM with Digital Payment, Bharati Ainapure, Shraddha Khamparia, Anupriya Varshney, Nidhi Baheti, 2022

The paper titled "IoT Enabled Smart Water ATM with Dig- ital Payment" addresses the growing need for water manage- ment solutions, particularly in developing nations where access to clean water remains a significant challenge. With only 3the world's freshwater being usable, much of it allocated to agriculture, the increasing global population has put immense pressure on water resources. Many underprivileged households in urban areas, especially in cities of developing nations like India, do not have access to piped water and rely on unsafe sources such as rivers, private vendors, and wells. This lack of reliable water sources has serious economic and health impacts, with millions of people suffering from waterborne diseases due to poor water quality. In response, innovative solutions like water ATMs, which dispense clean water in ex- change for payment via digital systems, are emerging as viable alternatives. These ATMs, backed by organizations like the World Bank and Asian Development Bank, provide a smart, low-cost method to deliver safe, potable water to underserved communities, contributing to the Sustainable Development Goal of global access to clean water by 2030. Water ATMs are particularly significant in India's water management land- scape, where the country faces widespread water stress and pollution. With 70India's water being unsafe for consumption, and millions affected by waterborne diseases like diarrhea, water ATMs offer an accessible solution. Operated through coin or card payment systems, they provide clean water to communities while reducing reliance on expensive bottled water, which also contributes to plastic waste. Companies like JanaJal, founded in 2013, have led the charge in implementing water ATMs across urban and rural areas, guided by the principles of making clean water Available, Accessible, and Affordable (AAA). These devices are becoming increasingly common at public places like bus stops, temples, and railway stations in major cities. Despite their success, there is still limited research on the broader social, economic, and material implications of water ATMs, especially regarding their impact on relationships between governments, citizens, and private sectors in managing water resources.

3. WORKING

A. The Coin Operated Water ATM with Bottle Dispenser system follows these steps for operation:

a. System Initialization: TheRaspberryPi initializes all com- ponents, including the coin acceptor, relay, water sensors, and display.

b. User Selection: The user selects between Water or Bottle Water using the touch screen display. For water options, the user can choose 250ml, 500ml, or 1 Litre For bottled water, only the 500ml bottle option is available.

c. Coin Insertion Prompt: The system prompts the user to insert the correct coin based on their selection. For example, 2 for 250ml, 5 for 500ml, and 10 for 1 litre or bottled water.

- Coin Detection and Validation: The coin acceptor sends pulses corresponding to the coin inserted:

1 pulse = 10

2 pulses = 5

3 pulses = 2

- The system verifies if the inserted coin matches the selected option. If valid, the display shows "Coin Detected. Dispensing Starting..." If invalid, it displays "Invalid Coin. Try Again."
- Water Dispensing Process: If the coin is valid, then the IR sensor will detect the presence of water bottle, as the bottle is detected the relay activates the water pump to dispense the chosen quantity. A progress bar animation provides visual feedback during dispensing. The system then resets, ready for the next transaction
- Water Quality Check (Safety Feature): Before dispensing, the TDS, pH, and turbidity sensors check the water qual- ity. If the water is unsafe, the system cancels the process and alerts the user. The water condition tracking system is embedded into the Coin Operated Water ATM to ensure the dispensed water meets safe drinking standards. It uses three key sensors — TDS Sensor, pH Sensor, and Turbidity Sensor — interfaced with the Raspberry Pi via an MCP3008 ADC (Analog-to-Digital Converter)

B. Sensors Used and Their Role

- **TDS Sensor (Total Dissolved Solids):** Measures the concentration of dissolved salts, minerals, and impurities in the water. TDS range for drinking water: 50 – 150 ppm. Values above this may indicate contamination.
- **pH Sensor:** Measures the acidity or alkalinity of the water. The pH of safe drinking water should fall within the range of 6.5 – 8.5. A pH outside thisrange may indicate harmful substances.
- **Turbidity Sensor:** Measures the cloudiness or haziness of the water. High turbidity suggests suspended particles, reducing water clarity.

C. Working Process

- **Initialization**: When the system starts, the Raspberry Pi initializes the TDS, pH, and Turbidity sensors through the MCP3008 ADC for accurate analog readings.
- **Continuous Monitoring**: The sensors continuously mon- itor the water quality inside the tank. Each sensor's readings are processed, and values are compared against predefined safe limits.
- **Decision Making**: If all three sensor values are within safe ranges: The display shows "Water Quality: Safe" in green. The system allows the user to proceed with their water selection. If any sensor detects unsafe conditions, the display shows"Water Quality: Unsafe" in red. The dispensing process is blocked to prevent unsafe water distribution.
- **Display System**: A dedicated small display (on the left side of the main screen) shows real-time water quality status. The user can visually confirm the water's safety before inserting a coin.
- **Completion**: Once the selected quantity is dispensed, the display shows"Ready for Next Coin". The system is designed to be user-friendly, with clear instructions, ani- mations, and enhanced safety features, ensuring reliable and efficient

operation.

D. Circuit Diagram:

Fig. 3.1. Circuit Diagram

E. Block Diagram

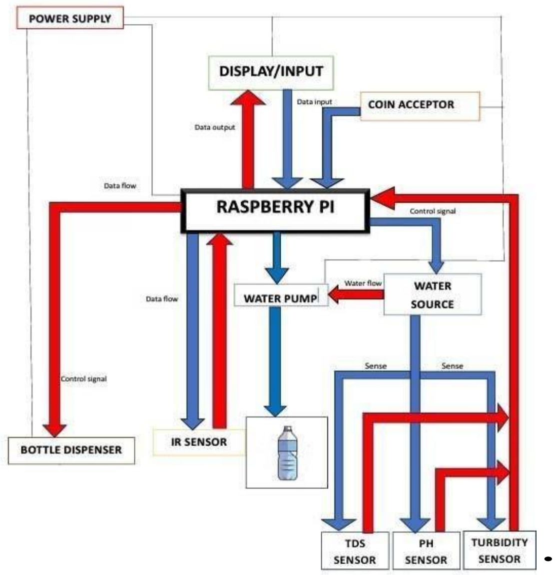


Fig. 3.2. Block Diagram

F. Methodology for Coin-Operated Water ATM with Bottle Dispenser:

- **Power Supply & Control Unit**

Raspberry Pi acts as the central controller, managing all inputs and outputs. A regulated power supply ensures stable operation of sensors, actuators, and the controller.

- **Coin Acceptance Validation**

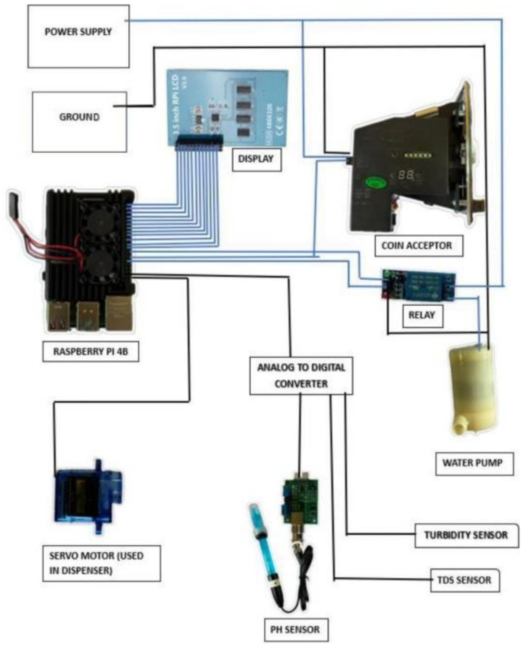
The Coin Acceptor verifies the coin's authenticity and sends a signal to the Raspberry Pi. Once verified, the system initiates the water dispensing process.

- **Water Quality Monitoring**

TDS Sensor: Checks the total dissolved solids in the water. Turbidity Sensor: Detects water clarity and any contamination. pH Sensor: Monitors acidity or alkalinity levels. These sensors continuously send data to the Rasp- berry Pi, ensuring water meets quality standards before dispensing.

- **Dispensing Mechanism**

If water quality is acceptable, the IR Sensor detects the presence of a bottle. The Bottle Dispenser releases a bottle (if needed). The Water Pump activates, allowing water to flow from the Water Source into the bottle.



User Interface Display

The Display/Input Unit provides feedback, showing: Coin validation status Water quality metrics

Water dispensing status

Users can interact via simple buttons or touch input. Data Flow Monitoring The system logs transactions and water quality data for future analysis. The Raspberry Pi sends signals to control components and processes input/output data.

This methodology ensures automatic, quality-controlled water dispensing while providing a seamless user experience.

F. Flow Chart

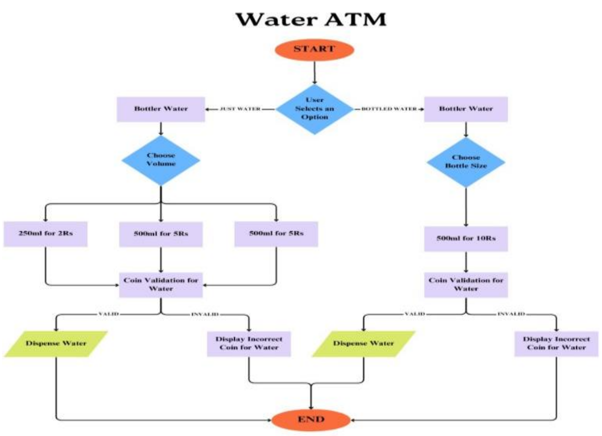


Fig. 3.3. Flow Chart

4. Cost Evaluation

5. Future Scope / Expected Outcomes

The future scope of the Coin Operated Water ATM with Bottle Dispenser lies in expanding its functionality and reach. Future iterations could integrate digital payment systems, allowing for mobile payments and reducing the reliance on physical coins, making the system more accessible and effi- cient. Incorporating solar power would enable deployment in off-grid areas, further enhancing its utility in remote regions. Additionally, IoT integration could offer real-time monitoring of water usage, bottle availability, and system health, enabling predictive maintenance and more effective resource manage- ment. Enhancements like water filtration systems and reusable bottle mechanisms could further improve water quality and sustainability, positioning the system as a key solution to water scarcity and environmental challenges. The project could also expand to include the distribution of other essential resources, such as food or hygiene products, making it a versatile, multi- purpose system for underserved communities. The expected outcome of this project is the creation of a reliable, user- friendly, and scalable system that provides clean drinking water to people in underserved areas. By offering a controlled, pay-per-use water distribution model, it will promote efficient resource management while ensuring ease of use through a simple coin-operated mechanism. The system will minimize water waste and ensure uninterrupted service through real-time monitoring of water levels and bottle availability. It will also reduce the environmental impact of plastic waste, particularly if reusable bottle features are introduced. Overall, the project will provide a sustainable, low maintenance solution to water access challenges, improving public health and setting the foundation for future technological innovations in resource distribution.

6. RESULTS

The graph represents the observed values of TDS, pH level, and turbidity across multiple test cases.

TABLE I
Cost Evaluation

Components	Cost
1.) Raspberry Pi	Rs. 5700
2.) Coin Acceptor	Rs. 1500
3.) Water Pump	Rs. 500
4.) Display Pi	Rs. 1500
5.) Enclosure (Box/Casing)	Rs. 1500
6.) Sensors	Rs. 3000
Estimated Cost Range	**Rs. 13700**

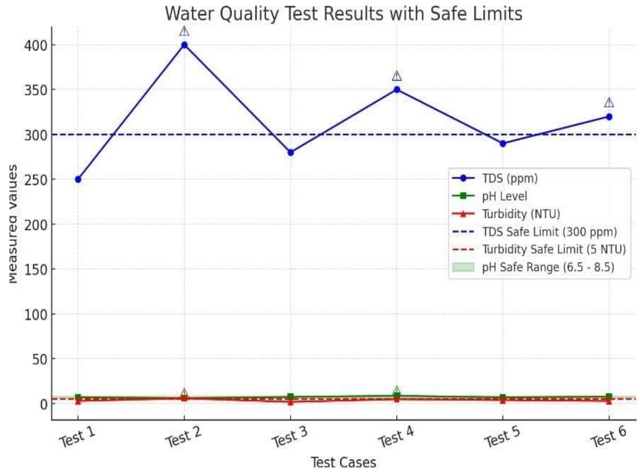


Fig. 6.1. Results

- Each parameter is compared against its defined safe limit to determine water quality.
- The TDS values, represented by the blue line, fluctuate across test cases, with Test 2 exceeding the safe limit of 300 ppm, indicating possible contamination.
- The pH levels, represented by the green line, are com- pared to the safe range of 6.5 to 8.5, with Test 2 (6.0) and Test 4 (8.8) falling outside the acceptable range.
- The turbidity, represented by the red line, remains mostly within the 5 NTU safe limit, except for Test 4, which exceeds the threshold, indicating impurities.
- The graph helps identify unsafe test cases, particularly Test 2 and Test 4, which have one or more parameters exceeding safe limits.
- Water samples from the other test cases meet the required standards and are considered safe for consumption.

- This analysis allows for quick identification of unsafe water conditions and highlights the need for corrective measures when necessary

Test No.	TDS Value (ppm)	pH Value	Turbidity (NTU)	Water Quality Status
1	120	7.2	0.5	✅ Safe
2	180	7	0.8	✅ Safe
3	250	6.5	1.2	⚠️ Borderline
4	350	5.8	2.5	❌ Unsafe
5	400	8	1.8	❌ Unsafe
6	90	7.5	0.3	✅ Safe
7	230	6.8	1	⚠️ Borderline
8	370	5.5	3	❌ Unsafe
9	150	7.3	0.6	✅ Safe
10	280	6.2	1.5	⚠️ Borderline

Fig. 6.2. Results for water Quality

Safe Limits:

- **TDS**: 50–300 ppm (Safe), 300–500 ppm (Borderline)> 500 ppm (unsafe)
- **pH**: 6.5–8.5 (Safe), <6.5 or >8.5 (Unsafe)
- **Turbidity**: 0–1 NTU (Safe), 1–2 NTU (Borderline), > 2

NTU (Unsafe)

Fig. 6.3. Results of Dispenser

Sr. No	Test Condition	Input (Coin/Command)	Expected Output	Observed Output	Status
1	Insert ₹2 Coin (250ml Water)	₹2 Coin Detected	250ml Water Dispensed	250ml Water Dispensed	✅ Pass
2	Insert ₹5 Coin (500ml Water)	₹5 Coin Detected	500ml Water Dispensed	500ml Water Dispensed	✅ Pass
3	Insert ₹10 Coin (1L Water)	₹10 Coin Detected	1 Litre Water Dispensed	1 Litre Water Dispensed	✅ Pass
4	Insert ₹10 Coin (500ml Bottle)	₹10 Coin Detected	500ml Bottle Dispensed	500ml Bottle Dispensed	✅ Pass
5	Insert Invalid Coin (e.g. ₹1)	Invalid Coin Detected	Display "Invalid Coin. Try Again."	Display "Invalid Coin. Try Again."	✅ Pass
6	Coin Inserted Without Bottle Presence	₹10 Coin Detected	Display "Place Bottle First"	Display "Place Bottle First"	✅ Pass
7	Water Quality Display Malfunction	Sensor Error Detected	Display "Sensor Error. Check System."	Display "Sensor Error. Check System."	✅ Pass
8	Coin Inserted During Water Dispensing	₹10 Coin Detected	Display "Please Wait, Dispensing in Progress."	Display "Please Wait, Dispensing in Progress."	✅ Pass
9	Water Purifier Failure During Operation	Sensor Error Detected	Display "Purifier Error. Contact Support."	Display "Purifier Error. Contact Support."	✅ Pass
10	Power On with All Components Connected	System Start-up	Display "System Ready"	Display "System Ready"	✅ Pass
11	Coin Inserted and Relay Malfunction	₹10 Coin Detected	Display "System Error. Contact Support."	Display "System Error. Contact Support."	✅ Pass
12	Emergency Stop Button Pressed	Emergency Stop Triggered	Display "Emergency Stop Activated" & System Halt	Display "Emergency Stop Activated" & System Halt	✅ Pass

7. CONCLUSION

The **Coin Operated Water ATM with Bottle Dispenser** is an innovative and practical solution to tackle the world- wide issue of ensuring safe potable water in disadvantaged regions. By leveraging automation and embedded systems, the project demonstrates how technology can simplify access to essential resources, reduce waste, and promote sustainability. The system's ability to dispense both water and bottles in exchange for coins, combined with real-time monitoring of resource availability, ensures efficient use of water and minimal human intervention. Its user-friendly design and potential for future enhancements, such as digital payments, solar power integration, and reusable bottle systems, make it scalable and adaptable to a wide range of environments, from urban public spaces to remote, off-grid communities. The project highlights the power of **technology-driven solutions** in resource management and shows promise for future expansions in other critical areas such as food and hygiene product distribution. By offering a **reliable, cost- effective, and sustainable model** for water distribution, this system has the potential to make a lasting positive impact on public health, environmental sustainability, and resource access in regions that need it most.

Refrences

[1] Bharati Ainapure, Shraddha Khamparia, Anupriya Varshney, Nidhi Ba- heti, "IoT Enabled Smart Water ATM with Digital Payment," 2022 3rd International Conference on Intelligent Engineering and Management (ICIEM) ©2022 IEEE, April 1955.

[2] Ajith Jerom B, Manimegalai R, Ilayaraja V, "An IoT Based Smart Water Quality Monitoring System using Cloud," 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE) ©2020 IEEE.

[3] Aditi Mohan, Niyati Tiwari, Rajdeep Ghosh, Prof. A.A Shinde, "Fine particles, thin films and exchange anisotropy," in *Magnetism*, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.

[4] Prateek Singh, Mukesh Kumar Lohani, Riya Nagarkoti, Swapnendu Chakrabarti, P B Karandikar, "Development of Secure Integrated Water ATM as a Smart System", 2021 International Conference on Artificial

Intelligence and Smart Systems (ICAIS) ©2021 IEEE.

[5] Chin Jung Huang, Fa Ta Tsai, ”Research and Development of a Practical Water Dispenser”, International Conference on Applied System Innovation IEEE-ICASI 2017 - Meen, Prior and Lam (Eds).

[6] Ali Nur Fathoni, Noor Hudallah, Riana Defi Mahadji Putri, Khusnul Khotimah, Tri Rijanto, Miftahul Ma'arif, ”Design Automatic Dispenser for Blind People based on Arduino Mega using DS18B20 Temperature Sensor ”, 2020 the third International Conference on Vocational Educa- tional and Electrical Engineering (ICVEE).

[7] Chengcheng Zhang, Jian Wu, Jiancheng Liu, ” Water quality monitoring system based on Internet of Things”, 2020 3rd International Conference on Electron Device and Mechanical Engineering (ICEDME).

[8] Ruturaj Marathe, Manisha Tapale, Vidya Jadhav, Vrushab Hulbatte, Aishwarya Pawar, ”IoT based Water Leakage Detection using Smart Objects for Smart City”, 2021 Third International Conference on In- telligent Communication Technologies and Virtual Mobile Networks (ICICV) ©2021 IEEE.