Design and Implementation of Arduino-Based Coin Operated Water Dispenser System

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Abstract : This research paper presents the design and implementation of an Arduino-based coin operated water dispenser system intended for public water distribution applications. The system automates the dispensing process using a programmable microcontroller, coin acceptor module, relay control unit, and water pump mechanism. The proposed system ensures controlled and hygienic water dispensing while minimizing wastage and reducing manual supervision. The research also discusses system architecture, hardware design, software implementation, operational workflow, advantages, limitations, and future enhancements. Experimental observations indicate improved efficiency and reliability compared to conventional manual systems.

Keywords **-Arduino, Coin Operated Water Dispenser, Automated Water Dispensing System, Microcontroller-Based System, Coin Acceptor Module.**

1.INTRODUCTION

Water is one of the most essential natural resources required for human survival. Public places such as railway stations, schools, colleges, hospitals, bus terminals, parks, and community centers require efficient systems for distributing drinking water to large numbers of users. Traditional water dispensing systems often involve manual operation or continuously running water outlets, leading to excessive wastage, leakage, misuse, and poor monitoring.

With advancements in embedded systems and automation technologies, intelligent control systems can be developed to improve the efficiency and reliability of water distribution. Automated water dispensing systems provide controlled access to water and reduce dependency on human supervision. Such systems are particularly useful in areas where resource conservation and operational efficiency are critical.

This research proposes an Arduino-based coin operated water dispenser system that automatically dispenses water when a valid coin is inserted. The system utilizes an Arduino UNO microcontroller to process signals received from a coin acceptor module. Upon successful validation of the coin, a relay module activates a water pump or solenoid valve for a predefined duration, allowing controlled dispensing of water.

The proposed system aims to provide a cost-effective, user-friendly and scalable solution for public water distribution while promoting responsible water consumption and reducing wastage.

2.OBJECTIVES

1.To design and develop a low-cost automated water dispensing system.
2.To minimize water wastage through controlled dispensing mechanisms.
3.To reduce manual operation and supervision requirements.
4.To improve hygiene and accessibility in public water distribution.
5.To provide a reliable and scalable solution for public utility applications.
6.To demonstrate the practical application of embedded systems in water management.

3.LITERATURE REVIEW

Automation has become an important component of modern utility systems. Various researchers have explored the use of embedded systems, microcontrollers, and IoT technologies for resource management applications.

Arduino-based automation systems are widely used because of their simplicity, affordability, and flexibility. Coin operated systems have been successfully implemented in vending machines, parking systems, ticketing systems, and public utility services.

Integrating coin validation technology with water dispensing systems enables controlled access and reduces unnecessary consumption.

Recent studies on smart water management emphasize the importance of automation, sensor integration, remote monitoring, and IoT connectivity. These technologies help improve efficiency, reduce operational costs, and support sustainable resource utilization.

The present work combines embedded system technology with automated control mechanisms to create a practical and affordable water dispensing solution suitable for public deployment.

4.METHODOLOGY

The development methodology consists of three major stages:

4.1 Hardware Design

The hardware architecture integrates the following components:

- Arduino UNO microcontroller
- Coin acceptor module
- Relay module
- Water pump
- LCD display
- Power supply unit

4.2 Software Development

The software is developed using the Arduino Integrated Development Environment (IDE) and Embedded C programming language. The program continuously monitors pulse signals generated by the coin acceptor and activates the relay when a valid coin is detected.

4.3 Testing and Validation

The completed system undergoes multiple testing stages including:

- Coin detection testing
- Relay switching verification
- Water dispensing duration testing
- System reliability evaluation
- Continuous operation testing

The performance of the automated system is compared with conventional manual dispensing methods.

5. SYSTEM ARCHITECTURE

The proposed system consists of input, processing, and output units.

Input Section

The coin acceptor acts as the input device. When a user inserts a valid coin, the module generates electrical pulse signals.

Processing Section

The Arduino UNO receives and processes the pulse signals. The microcontroller determines whether the coin is valid and initiates dispensing operations.

Output Section

The relay module receives control signals from the Arduino and activates the water pump. The LCD display provides user feedback regarding system status.

Block Diagram

Figure 1: Block Diagram of Arduino-Based Coin Operated Water Dispenser System

Coin Acceptor → Arduino UNO → Relay Module → Water Pump

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LCD Display

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6. WORKING PRINCIPLE

The operation of the system follows a sequential process:

Step 1: Coin Insertion

The user inserts a coin into the coin acceptor module.

Step 2: Coin Validation

The coin acceptor identifies the coin and generates pulse signals corresponding to the accepted denomination.

Step 3: Signal Processing

The Arduino UNO receives the pulse signal through an interrupt pin and verifies the coin input.

Step 4: Relay Activation

Upon successful validation, the Arduino activates the relay module.

Step 5: Water Dispensing

The relay powers the water pump or solenoid valve, allowing water flow for a predefined duration.

Step 6: System Reset

After dispensing is completed, the relay is deactivated and the system returns to standby mode awaiting the next transaction.

7. HARDWARE COMPONENTS

7.1 Arduino UNO

Fig.1 Arduino UNO

The Arduino UNO serves as the central controller of the system. It is based on the ATmega328P microcontroller and provides digital and analog input/output interfaces.

Features

- Operating Voltage: 5V
- Digital I/O Pins: 14
- Analog Inputs: 6
- Flash Memory: 32 KB
- Clock Speed: 16 MHz

7.2 Coin Acceptor Module

Fig.2 Coin Acceptor Module

The coin acceptor detects and validates inserted coins. It generates pulse signals that are interpreted by the Arduino.

Functions

- Coin recognition
- Pulse generation
- Fraud prevention

7.3 Relay Module

Fig.3 Relay Module

The relay acts as an electrically controlled switch that enables the Arduino to operate high-power devices safely.

Functions

- Electrical isolation
- Pump control
- Reliable switching

7.4 Water Pump

The pump transfers water from the storage tank to the dispensing outlet.

Functions

- Controlled water delivery
- Efficient operation

- Continuous service capability

7.5 LCD Display

The LCD provides information to users regarding system status and instructions.

Display Messages

- INSERT COIN
- PROCESSING
- DISPENSING WATER
- THANK YOU

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8. Software Description

The software is developed using Arduino IDE and Embedded C language.

The program uses interrupt-based programming techniques to ensure accurate detection of pulse signals generated by the coin acceptor. The interrupt service routine increments a counter whenever a coin pulse is received. When a valid coin count is detected, the Arduino activates the relay and initiates water dispensing.

This approach improves system responsiveness and reduces processor workload compared to continuous polling methods.

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9. Arduino Program

```
const int coinPin = 2;
const int relayPin = 8;

volatile int coinInserted = 0;

void coinISR()
{
 coinInserted++;
}

void setup()
{
 pinMode(coinPin, INPUT_PULLUP);
 pinMode(relayPin, OUTPUT);

 digitalWrite(relayPin, LOW);

 attachInterrupt(
    digitalPinToInterrupt(coinPin),
    coinISR,
    FALLING);
}

void loop()
{
 if (coinInserted > 0)
 {
  coinInserted = 0;

  digitalWrite(relayPin, HIGH);

  delay(5000);
```

```
    digitalWrite(relayPin, LOW);
  }
}
```

10. Results and Discussion

Experimental testing demonstrated successful operation of all hardware and software modules.

Observed Results

- Accurate coin detection
- Reliable relay switching
- Consistent water dispensing duration
- Reduced water wastage
- Improved operational efficiency

11.Conclusion

The Arduino-based coin operated water dispenser system presents an effective, economical, and environmentally sustainable solution for automated public water distribution. The integration of Arduino UNO, coin acceptor module, relay control unit, and water dispensing mechanism enables reliable and controlled operation while minimizing water wastage.

The automated dispensing process eliminates the need for continuous manual supervision and improves resource management. Experimental evaluations confirm that the system performs efficiently under normal operating conditions and provides significant advantages over conventional dispensing methods.

The affordability, modularity, and scalability of the proposed design make it suitable for implementation in public places such as railway stations, schools, hospitals, bus terminals, and community water kiosks. Furthermore, future enhancements involving IoT technologies, digital payment systems, and intelligent monitoring capabilities can transform the system into a comprehensive smart water management solution.

Therefore, the proposed system contributes to sustainable water utilization practices and demonstrates the practical potential of embedded systems in addressing real-world public utility challenges.

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