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Water ATM Based on RFID and GSM

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Abstract: *Now a day's water vending machines are available and operated on only one coin but our aim is to design water vending machine which operates on smartcards. In India there is problem of safe drinking water therefore we are going to provide mineral water. Water has become the most commercial products of the century. This may sound bizarre, but true. The stress on the multiple water resources is a result of a multitude of factors. On the one hand, the rapidly rising population and changing lifestyles have increased the need for fresh water. So is the panic over drinking water supply in the city as well as in villages. The reservoir has just 35.63 feet of water, which is not even half of the total water level. With the present arrangement of reduced frequency of water supply. Meanwhile, other sources of water such as tanks have dried up. As the problem of water shortage has been increasing by the day, slum-dwellers are being forced to fetch water from other sources located at a distance from their houses. There have been reports of quarrels between slum-dwellers over fetching water from public taps*

Keywords: Radio Frequency Identification (RFID), Infrared Radiation (IR), Global subscriber Identity Module (G.S.M)

I. INTRODUCTION

In today's world, real-time environmental Access to clean and safe drinking water is a pressing challenge in many regions, particularly in areas affected by water scarcity or lacking adequate infrastructure. Traditional water distribution methods often prove inefficient, unreliable and prone to wastage, leaving many communities underserved. In response to this issue, the development of Water ATMs has emerged as an innovative solution. Water ATMs, equipped with RFID (Radio Frequency Identification) and GSM (Global System for Mobile Communications) technologies, provide a streamlined and efficient means of delivering water to users. RFID enables secure and automated user identification, while GSM facilitates remote monitoring, real-time communication and system control. These systems offer a sustainable, scalable approach to water distribution, ensuring equitable access, reducing wastage and promoting responsible consumption. By leveraging these modern technologies, Water ATMs have the potential to revolutionize water access, providing a reliable and user-friendly solution that meets the growing demand for clean water in underserved regions.

II. LITERATURE SURVEY

In the nineteenth century, the first vending machine to be successfully commercialized by Thomas Adams was used for the sale of their chewing gum in underground stations of New York. Only in 1902 the first company of vending machines emerged, Horn & Hardart Baking Company in Philadelphia. In turn, the Committee Definitions of the American Marketing Association define vending machines as "retail sales of products or services by operating machines that are used by end consumers" (STEIN, 1964). Market developed via automatic vending machines has grown quickly since it is convenient, faster and cheaper (KIM, YOO, 2012). According to history, the coffee vending machines Abstract: Now a day's water vending machines are available and operated on only one coin but our aim is to design water vending machine which operates on smartcards. In India there is problem of safe drinking water therefore we are going to provide mineral water. Water has become the most commercial products of the century. This may sound bizarre, but true. The stress on the multiple water resources is a result of a multitude of factors. On the one hand, the rapidly rising population and changing lifestyles have increased the need for fresh water. So is the panic over

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drinking water supply in the city as well as in villages. The reservoir has just 35.63 feet of water, which is not even half of the total water level. With the present arrangement of reduced frequency of water supply. Meanwhile, other sources of water such as tanks have dried up. As the problem of water shortage has been increasing by the day, slum-dwellers are being forced to fetch water from other sources located at a distance from their houses. There have been reports of quarrels between slum-dwellers over fetching water from public taps.

III. COMPONENTS

- **RFID Reader (MFRC522):** This is used to read the user's RFID card when they scan it.
- **SIM800L Module:** This is a module used for sending SMS messages to users.
- **LCD Screen:** A screen that displays status messages (like user details, balance, etc.).
- **Motor Control Pins:** These control the motor that dispenses water.
- **EEPROM:** This is used to store information about the users (like their RFID card IDs, water balance and phone numbers).

IV. METHOD

This is an automated water dispensing system. The user taps their RFID card and the system checks if they have enough balance. If so, it gives them 1 litre of water, updates their balance and sends them a confirmation SMS. If not, it tells them they have insufficient balance. These sensors give square wave output which is proportional to the quality of the water. These sensors output from GSM is gives message to the owner where leakage is identified. RFID is used for identification of user i.e.to measure amount of water used by consumer and according to uses billing can be done.

V. PROGRAMMING OF WATER ATM BASED ON RFID AND GSM

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <SPI.h>
#include <MFRC522.h>
#include <SoftwareSerial.h>
#include <EEPROM.h>
#define SS_PIN 10
#define RST_PIN 9
MFRC522 rfid(SS_PIN, RST_PIN);
SoftwareSerial sim800(7, 8);  // RX, TX for SIM800L
LiquidCrystal_I2C lcd(0x27, 16, 2);
// Motor control pins
#define ENB 6
#define IN3 2
#define IN4 4
// User structure
struct User {
  char rfidCardID[12];
  float balance;
  char name[20];
  char phoneNumber[15];
};
const int numUsers = 2; // no of users
User users[numUsers] = {
  {"d327a5c5", 2.0, "Harsh", "+918591158479"}, //UID(RFID No), No. of litre, Username, Mobile.no
  {"", 5.0, "Asawari", "+919405262762"}
};
```

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```
const int eepromBaseAddress = 0;
const int userSize = sizeof(User);
unsigned long motorStartTime = 0;
bool motorRunning = false;
void setup() {
  Serial.begin(9600);
  sim800.begin(9600);
  SPI.begin();
  rfid.PCD_Init();
  lcd.init();
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("System Ready");
  pinMode(ENB, OUTPUT);
  pinMode(IN3, OUTPUT);
  pinMode(IN4, OUTPUT);
  initializeUsers();
  printAllUsers();
}
void loop() {
  checkMotorTimeout();
  if (rfid.PICC_IsNewCardPresent() && rfid.PICC_ReadCardSerial()) {
    String cardUID = getCardUID();
    Serial.print("Card UID: ");
    Serial.println(cardUID);
   int userIndex = findUserByCardID(cardUID);
    if (userIndex != -1) {
      User currentUser;
      readUser(userIndex, currentUser);
      Serial.println("Valid card!");
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("User: " + String(currentUser.name));
  float waterWithdrawn = 1.0;
      if (currentUser.balance >= waterWithdrawn) {
        currentUser.balance -= waterWithdrawn;
        writeUser(userIndex, currentUser);
        Serial.print("Water withdrawn: ");
        Serial.println(waterWithdrawn);
        Serial.print("Remaining balance: ");
        Serial.println(currentUser.balance);
        lcd.setCursor(0, 1);
        lcd.print("Bal: ");
        lcd.print(currentUser.balance, 2);
        sendSMS(currentUser.phoneNumber, "Hey " + String(currentUser.name) + ", Water withdrawn: " +
String(waterWithdrawn) + "L. Remaining: " + String(currentUser.balance) + "L.");
        motorOn();
      } else {
        Serial.println("Insufficient balance!");
```

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```
        lcd.clear();
        lcd.print("Insufficient Bal!");
       }
      } else {
       Serial.println("Invalid card!");
       lcd.clear();
       lcd.print("Invalid Card!");
      }
      rfid.PICC_HaltA();
      rfid.PCD_StopCrypto1();
    }
    rfid.PCD_Init();
    delay(50);
}
String getCardUID() {
    String uid = "";
    for (byte i = 0; i < rfid.uid.size; i++) {
      uid += String(rfid.uid.uidByte[i], HEX);
    }
    return uid;
}
void motorOn() {
    Serial.println("Motor ON...");
    analogWrite(ENB, 255);
    digitalWrite(IN3, HIGH);
    digitalWrite(IN4, LOW);
    motorStartTime = millis();
    motorRunning = true;
}
void motorOff() {
    Serial.println("Motor OFF...");
    analogWrite(ENB, 0);
    digitalWrite(IN3, LOW);
    digitalWrite(IN4, LOW);
    motorRunning = false;
}
void checkMotorTimeout() {
    if (motorRunning && millis() - motorStartTime >= 3000) {
      motorOff();
    }
}
void sendSMS(String phoneNumber, String message) {
    sim800.println("AT+CMGF=1");  // Text mode
    delay(1000);
    sim800.print("AT+CMGS=\"");
    sim800.print(phoneNumber);
    sim800.println("\"");
    delay(1000);
    sim800.println(message);
```

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```
  sim800.write(26);  // Ctrl+Z to send
  Serial.println("Sending SMS...");
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Sending SMS...");
  unsigned long startTime = millis();
  String response = "";
  bool smsSent = false;
  while (millis() - startTime < 5000) {
    while (sim800.available()) {
      char c = sim800.read();
      response += c;
      if (response.indexOf("+CMGS:") != -1) {
        smsSent = true;
        break;
      }
    }
    if (smsSent) break;
  }
  if (smsSent) {
    Serial.println("SMS sent successfully!");
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("SMS Sent!");
  } else {
    Serial.println("SMS failed!");
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("SMS Failed!");
  }
  Serial.println("Response: " + response);
}
void initializeUsers() {
  for (int i = 0; i < numUsers; i++) {
    writeUser(i, users[i]);
  }
}
void writeUser(int index, User user) {
  int address = eepromBaseAddress + index * userSize;
  EEPROM.put(address, user);
}
void readUser(int index, User &user) {
  int address = eepromBaseAddress + index * userSize;
  EEPROM.get(address, user);
}
void printAllUsers() {
  Serial.println("Stored Users:");
  for (int i = 0; i < numUsers; i++) {
    User user;
```

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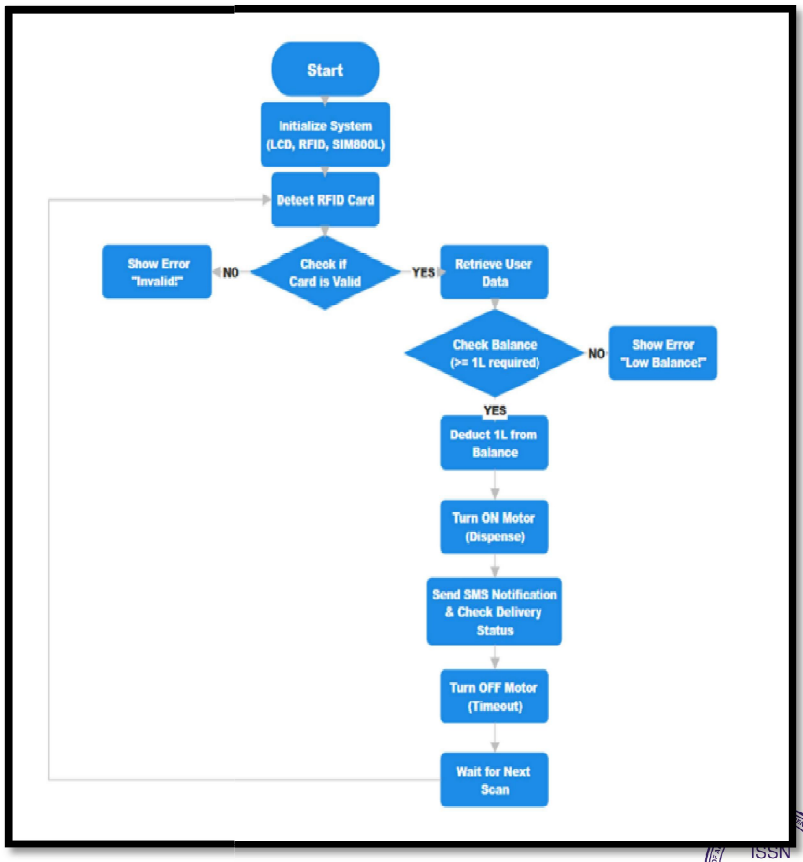
```
    readUser(i, user);
    Serial.print("RFID=");
    Serial.print(user.rfidCardID);
    Serial.print(", Name=");
    Serial.print(user.name);
    Serial.print(", Bal=");
    Serial.print(user.balance);
    Serial.print(", Phone=");
    Serial.println(user.phoneNumber);
  }
}
int findUserByCardID(String cardUID) {
  for (int i = 0; i < numUsers; i++) {
    User user;
    readUser(i, user);
    if (String(user.rfidCardID) == cardUID) {
      return i;
    }
  }
  return -1;
}
```

VI. FLOW CHART



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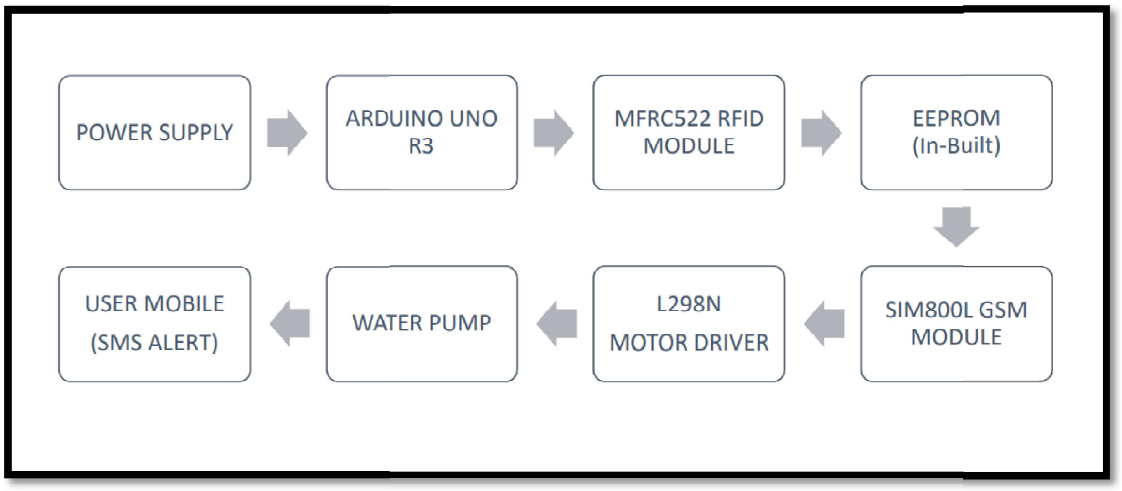
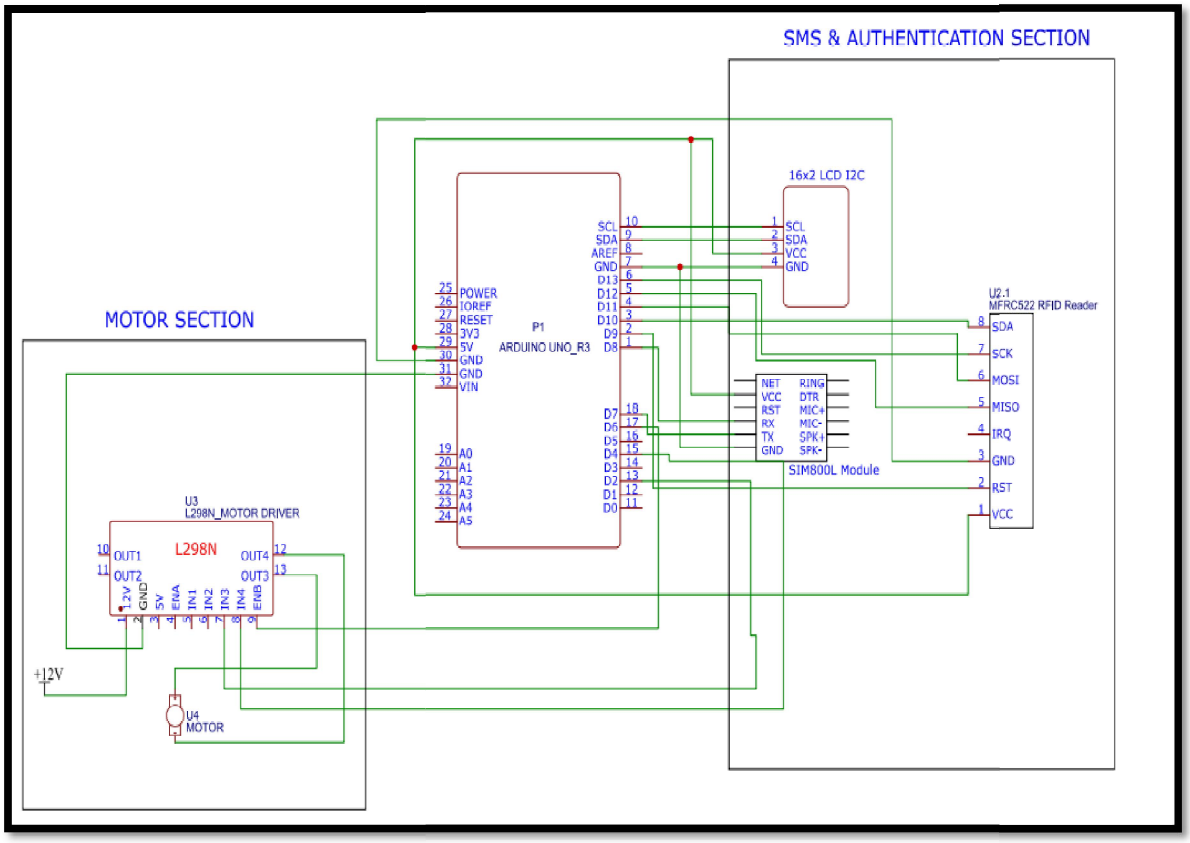
VII. BLOCK DIAGRAM



VIII. PIN DIAGRAM



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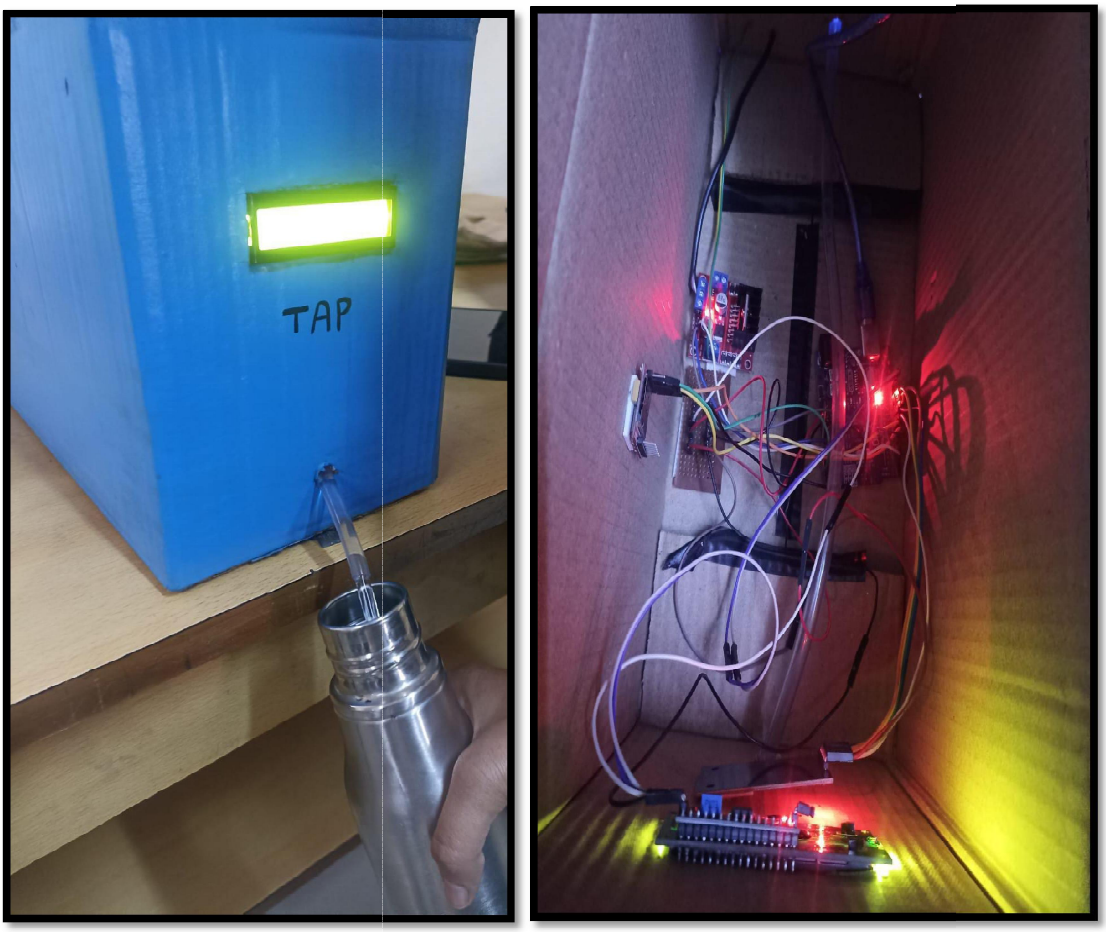
IX. RESULT



The setup part runs once when the system starts. It initializes the RFID reader, the LCD display and other components. It also loads the information about the users into memory (from EEPROM) and displays "System Ready" on the LCD. In the loop (which runs continuously), the system waits for the RFID card to be scanned: o If a card is scanned:

- It checks if the card ID matches any of the predefined users.
- If a match is found, it shows the user's name on the LCD and checks if they have enough balance for the water withdrawal.

If they have enough balance,

- It deducts the water withdrawn (1/2 liter).
- Sends an SMS to the user with the updated balance.
- Turns on the motor to dispense the water.
- If the balance is insufficient, it shows "Insufficient Bal!" on the LCD. o If no valid card is scanned, it shows "Invalid Card!" on the LCD.

The motor is controlled with two pins (IN3 and IN4). When a user withdraws water, the motor turns on. After 3 seconds, the motor turns off automatically to stop the water flow.

X. CONCLUSION

The Water ATM system is a cost-effective and sustainable solution to provide clean water to communities with limited access. By integrating RFID and GSM technologies, the system ensures controlled water access, promotes water

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conservation and offers real-time monitoring of usage. This system can significantly improve water distribution efficiency in rural and urban areas where water management is critical.

REFERENCES

[1] "Smart Water Technologies and Techniques: Data Capture and Analysis for Sustainable Water Management" Author: David A. Lloyd Owen Publisher: Wiley-Blackwell, 2018 o This book provides insights into smart water management systems, including how RFID and communication technologies like GSM can be applied to water distribution systems.

[2] "IoT-based Intelligent Modelling for Environmental and Ecological Engineering" Author: Paul Krause, Evgeny Katz Publisher: Springer, 2020 o Focuses on IoT and intelligent systems for environmental engineering, where applications of GSM and RFID can be applied to water management solutions.

[3] "RFID Technology: Principles, Applications and Challenges" Author: Syed A. Ahson, Mohammad Ilyas Publisher: CRC Press, 2008 o This book offers a comprehensive guide to RFID technology, including its use in various applications such as water ATM systems.

[4] RFID Journal, Website: www.rfidjournal.com

RFID Journal provides in-depth information, case studies and technological advancements related to RFID usage, including for public utilities like water ATMs.

[5] IEEE Xplore Digital Library, Website: https://www.ieeexplore.ieee.org

A vast repository of research papers and conference proceedings on RFID, GSM modules and their applications in smart utility management systems.

[6] Water ATM Project Using GSM and RFID (Techie Diaries), Website: https://www.techiediaries.com/water-atm-gsm-rfid/

A step-by-step guide on implementing a water ATM system, using GSM and RFID modules, with insights on the technology and code implementation.

[7] Electronic Projects Hub: GSM-Based Water ATM System, Website: https://www.electronicshub.org/gsm-water-atm/

This resource provides a detailed project explanation on building a Water ATM system using RFID and GSM modules, including the circuit diagrams and code.