Water Tank Level Controller Using Arduino

Introduction

Water scarcity is a growing global challenge. Currently, only about 25% of people worldwide have access to safely managed drinking water. This project addresses these challenges by using an Arduino-based system to automate water pump control based on tank level, conserving water and labor.

System Analysis

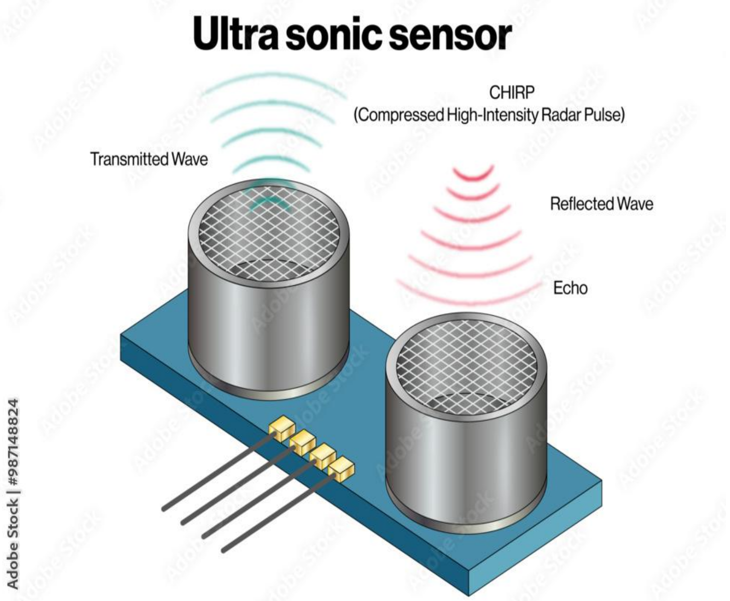
The system continuously measures the water level in a tank, displays it to the user, and switches the pump on or off automatically. It prevents overflow and dry-run, saving water and energy. It eliminates the need for manual monitoring and ensures real-time feedback.

Hardware and Software Components

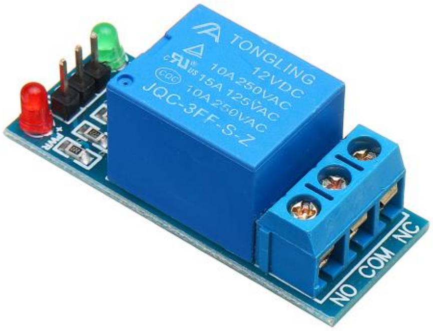
- Arduino Uno
- HC-SR04 Ultrasonic Sensor
- 16x2 LCD Display
- 5V Relay Module
- Submersible Pump
- Power Supply
- Arduino IDE
- Proteus software

Sensors and Actuators

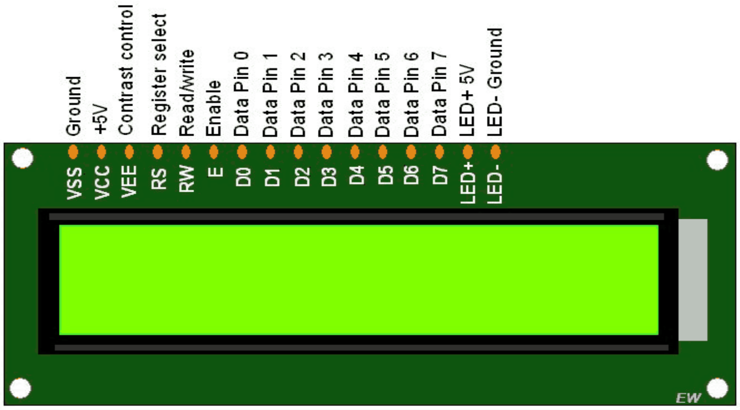
• Ultrasonic Sensor (HC-SR04): Ultrasonic sensor that works using the principle of EHCO. The sensor transmits ultrasonic waves, which reflect back upon hitting an obstacle (in this case, water surface). By measuring the time delay between transmission and reception, the distance to the water surface is calculated



• Relay Module (5V): The relay is an electrically operated switch that allows a low power Signal (from microcontroller like Arduino) to control a high-power device (like a bulb or motor).



• 16×2 LCD Display: A digital screen that displays 2 rows of 16 characters. It is used to show water level percentage and pump status. Example: The screen can display 'Water: 42%' and 'Pump: ON'.

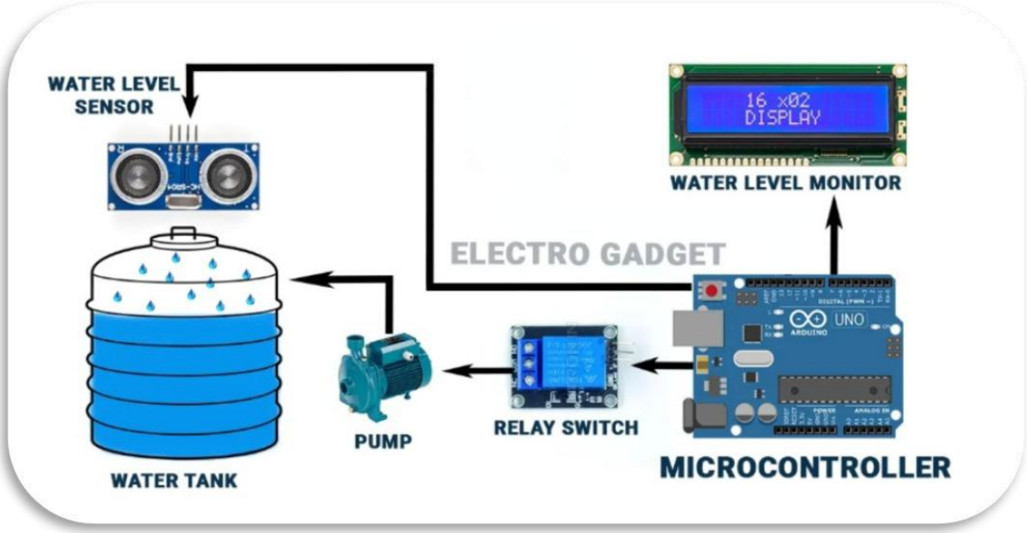


• Arduino Uno: The brain of the system, processing sensor data and controlling the pump.

- ATmega328 based
- 14 digital I/O pins
- USB connectivity

System Architecture

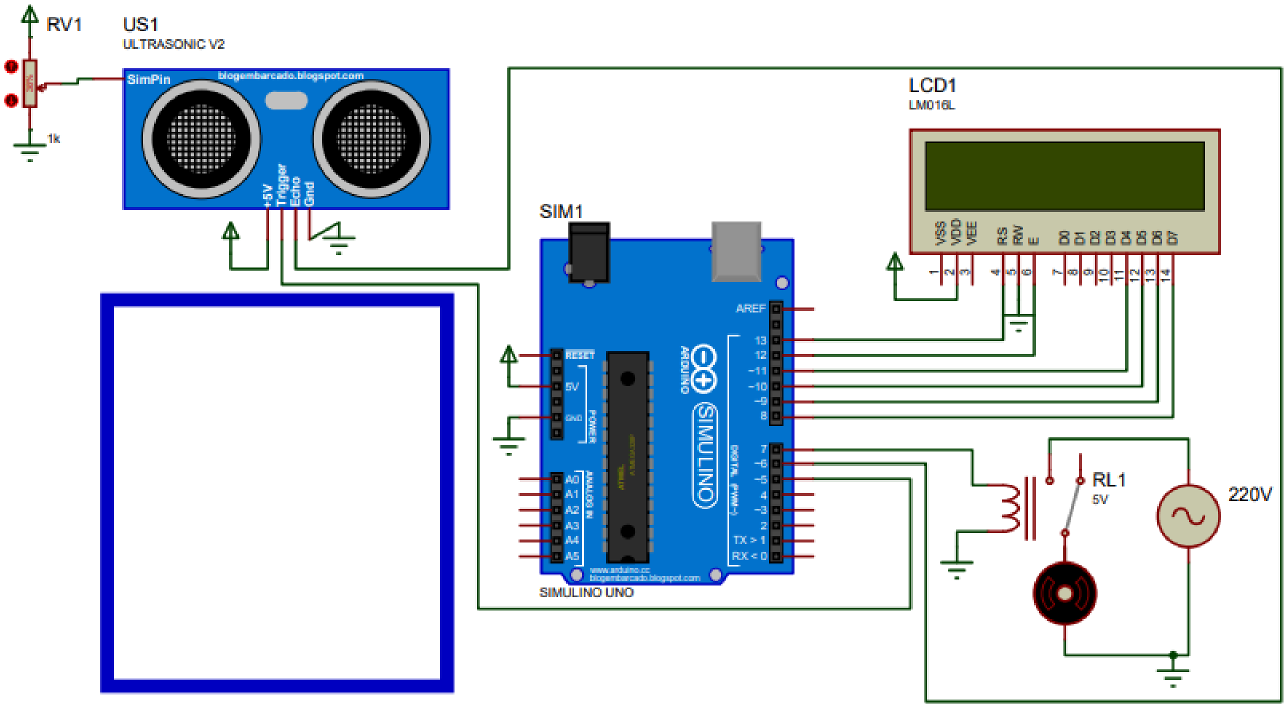
The HC-SR04 sensor is mounted on the tank to measure water level. The Arduino processes this data, displays it on the LCD, and controls a relay module that operates the pump.



Communication Protocols

The HC-SR04 uses digital I/O signals (trigger and echo). The LCD uses a parallel 4-bit interface. The relay is controlled by a digital output from the Arduino.

Circuit diagram



Source Code

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
const int trigPin = 5;
const int echoPin = 6;
const int Motor_Pin = 7;
long duration;
int distance;
bool Motor;
void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(Motor_Pin, OUTPUT);
  lcd.begin(16, 2);
}
void loop() {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;
  int Level = map(distance, 0, 1106, 0, 100);
  lcd.setCursor(0, 0);
  lcd.print("Water: ");
  lcd.print(Level);
  lcd.print("%     ");
  if (Level < 30) Motor = true;
  else if (Level >= 100) Motor = false;
  if (Motor) {
    digitalWrite(Motor_Pin, HIGH);
    lcd.setCursor(0, 1);
    lcd.print("Pump: ON      ");
  } else {
    digitalWrite(Motor_Pin, LOW);
    lcd.setCursor(0, 1);
    lcd.print("Pump: OFF     ");
  }
  delay(500);
}
```

Testing Snapshots

Snapshot 1: Sensor reading displayed on LCD.
Snapshot 2: Motor ON when water level < 30%.
Snapshot 3: Motor OFF when tank is full.

Implementation

The ultrasonic sensor is calibrated to detect water levels. Thresholds are set for pump ON (<30%) and OFF (≥100%). The LCD provides real-time feedback.

Limitations and Improvements

- Sensor inaccuracies with foam or turbulence.
- Add WiFi/GSM for remote monitoring.
- Add float sensor for redundancy.
- Add battery backup.

Applications

- Domestic: home tanks
- Agricultural: irrigation
- Industrial: boiler and process tanks
- Public utilities: water supply management

Advantages

- Prevents overflow and dry-run
- Saves electricity
- Simple and cost-effective
- Can be upgraded with IoT

Disadvantages

- Requires calibration
- Power dependency
- Sensor aging
- Initial setup effort

Conclusion

The system ensures reliable water management with minimal human intervention. It is scalable, affordable, and highly effective for diverse sectors.

References

- Arduino Uno Datasheet
- HC-SR04 Datasheet
- Arduino.cc
- Ignitec: IoT in Water Management
- World Economic Forum: Global Water Crisis

VOD Caste link

https://drive.google.com/file/d/1Zlxc-rdiBl_413scLZzDhLaghuItgwTX/view?usp=sharing