Automatic Rooftop Water Tank Control Switch

Embedded Systems

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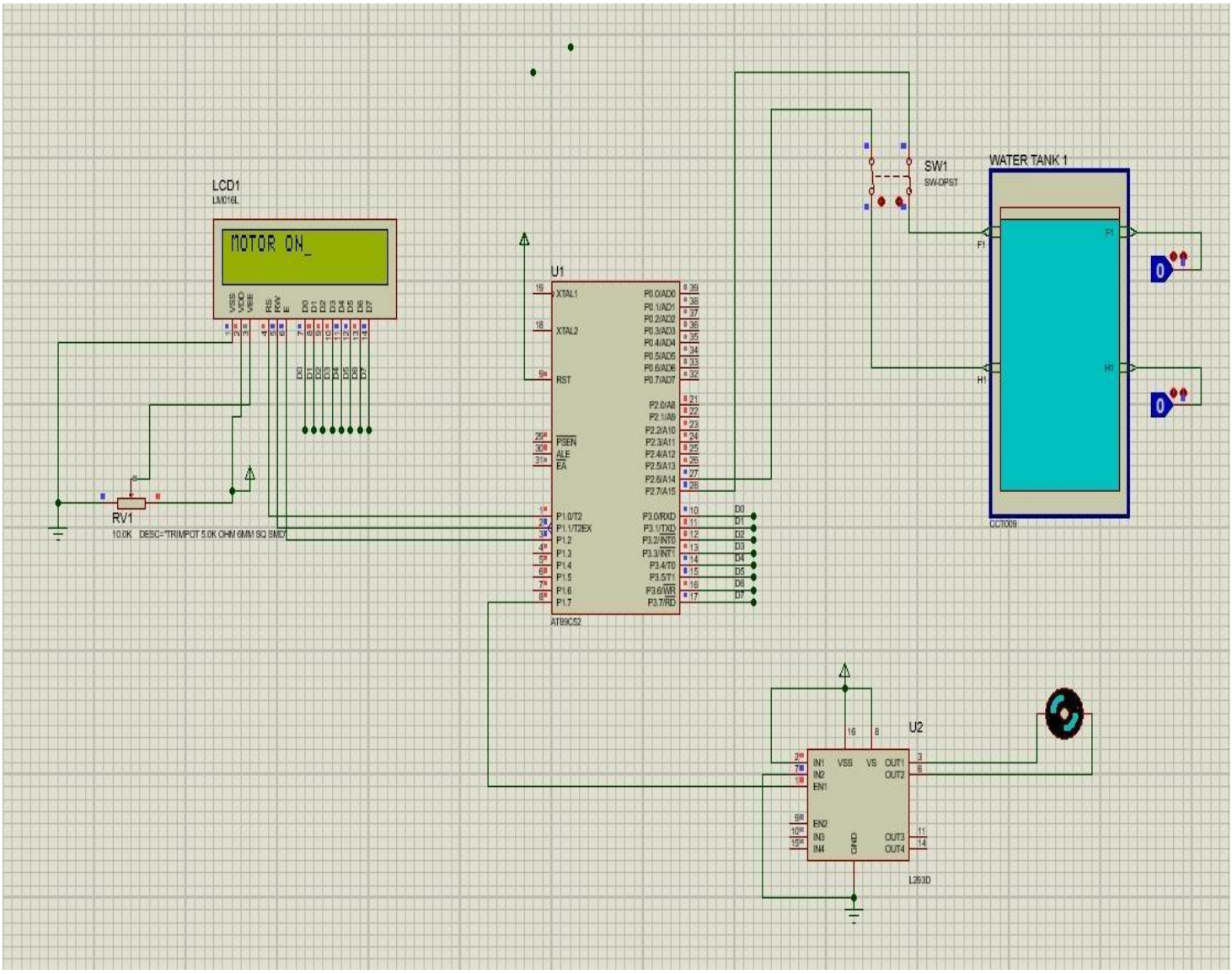
Objective:

To design an automated system using an 8051 microcontroller to monitor and control rooftop water tank levels, ensuring efficient water management and preventing overflow or shortages.

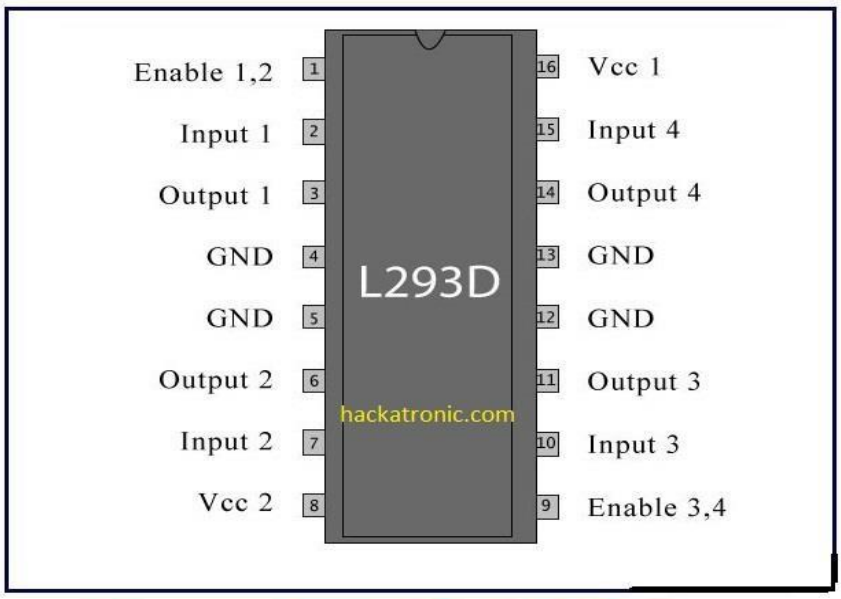
Bill of Components

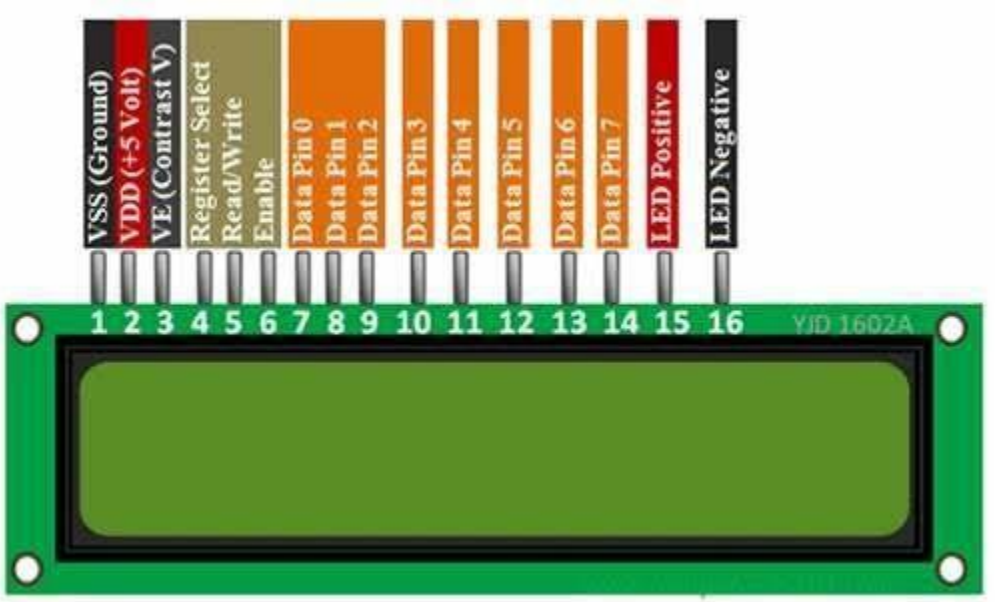
Name of item	Specification	Price
8051 Microcontroller	AT89C52	150
Development board & Adapter	----	400
Breadboard	----	80
Submersible pump	5V	50
Motor driver	L293D	160
LCD	16X2 alphanumeric	250
Float Sensors	----	200
Op-amp	IC-741	20
Resistor	2.2K,4.7K,5.6K	10
Jumper wire	-----	200
Potentiometer	B10k	25
Miscellaneous	Jars & pipe	150
Total		**1695**

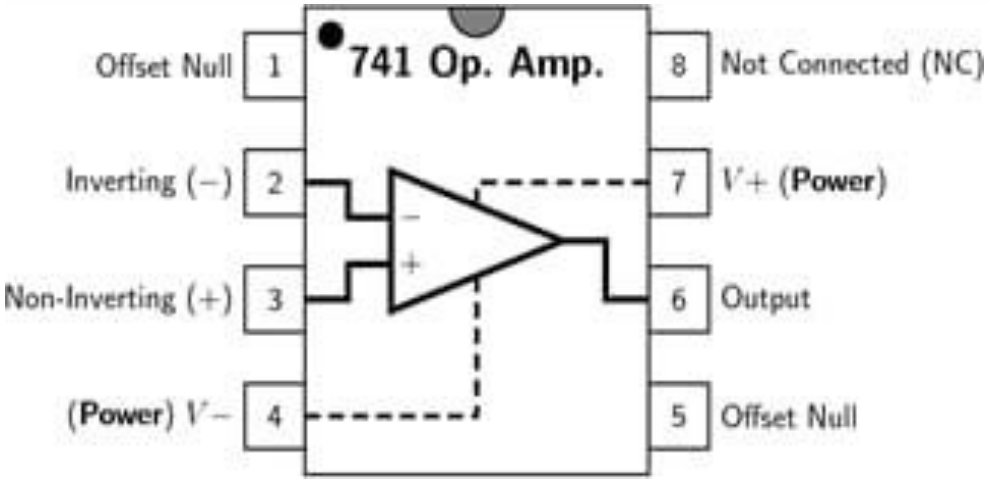
Circuit Diagram



Pin Diagram of Components







Implementation of Hardware

- **8051 Microcontroller: -**
  The AT89C52 microcontroller is utilized for hardware implementation and simulation. It serves as the central processing unit, controlling the system's operations based on the sensor inputs and logic circuitry.
- **Float Sensor: -**
  Float sensors are employed to detect water levels in the tank. When the water level reaches the float sensor, it generates a 1V DC signal, which is sent to the connected microcontroller port.
- **IC 741: -**
  The IC 741 operational amplifier is used to amplify the 1V signal from the float sensor to a voltage range of 1.9V to 5.5V, ensuring compatibility with the 8051 microcontroller's logic level requirements as specified in the datasheet.
- **Motor driver L293D: -**
  The L293D motor driver is integrated to control the submersible pump. It allows safe and efficient operation of the pump by isolating the high-current motor circuit from the microcontroller.
- **Submersible Pump: -**
  A 5V DC submersible pump is employed for water pumping. The motor pump is controlled based on predefined logic to fill the tank as per the water level detected by the sensors.
- **A 9V external dc supply: -**
  A 9V external DC power supply is used to drive the motor. This prevents high current from flowing through the microcontroller, ensuring its safety and longevity.
- **LCD display: -**
  A 16x2 LCD module is used to display system states such as “MOTOR ON,” “MOTOR OFF,” “TANK LOW,” and “TANK FULL.” This provides real-time feedback to the user on the system's operation.

Test Results

Top Sensor	Bottom Sensor	Previous State (Q_t)	Present State (Q_{t+1})
0	0	x	1
0	1	0	0
0	1	1	1
1	1	x	0

State 1: Water Level Below the Bottom Sensor

- When the water level falls below the bottom sensor, the motor is activated regardless of its previous state.
- This ensures the system prioritizes refilling the tank to maintain a minimum water level.

State 2: Water Level Between the Bottom and Top Sensors

- In this intermediate range, the motor's state remains unchanged.
- If the motor was previously running, it continues to operate. Conversely, if the motor was off, it remains off.
- This state helps maintain system stability by preventing unnecessary state changes.

State 3: Water Level Above the Top Sensor

- When the water level exceeds the top sensor, the motor is immediately deactivated.
- This prevents overfilling of the tank, ensuring efficient water usage and system safety.

Conclusion

The project on automatic rooftop water tank switching offers an efficient and practical solution to water management challenges. By using float sensors and 8051 microcontroller, the system automates the filling of water tanks, eliminating the need for manual monitoring and reducing issues like water wastage due to overflow. The float sensor accurately detects water levels, and the microcontroller processes this data to control the pump's operation.

The LCD display provides real-time status updates, enhancing user interaction and system transparency. This project demonstrates the effective integration of sensor technology with embedded systems for sustainable daily life applications. The design is cost- effective, user-friendly, and reliable, with potential for future enhancements such as IoT integration for remote monitoring and control, increasing its scalability and functionality.