# Water Level Control System


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1. **Motivation**: We chose the water level control system to prevent overflow and flooding, ensuring optimal water usage and maintaining consistent water pressure. This system protects equipment from damage and enables efficient water management. Addressing these issues is crucial for sustainable water use, environmental protection, and infrastructure longevity, making this project both impactful and essential.

2. **Problem Statement**: A Water level control system is a device or mechanism that automatically monitors and regulates the level of water In the tank, reservoir, or any other water storage system.

   The water is controlled in 2 Ways :

   (1) Automatic Method

   (2) Manual Method

**Automatic Method :**

- A Water Level Control System is a technological solution designed to automatically regulate and maintain the water level within a specific range or at a predetermined set point.
- This system typically employs wires in the tank to detect the water level and actuator (Relay) to adjust the flow of water accordingly.
- It is commonly used in applications where precise and continuous control of water levels is required, such as in industrial processes, irrigation systems, and water treatment plants.

**Manual Method :**

- The manual method of controlling water levels is designed for users who prefer to operate the system manually, without relying on automated controls.
- This method provides users with the flexibility to control the water level according to their specific needs and preferences, but it may require more attention and effort compared to automated systems.

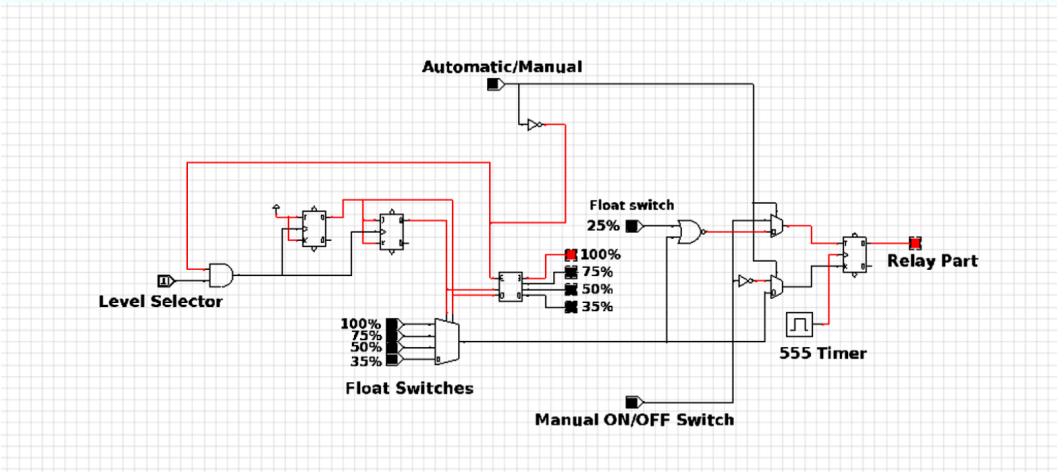
3. **Design Procedure**:

System Components :

| Components | Quantity |
|---|---|
| Breadboard | 2 |
| Connecting Wires | As Requried |
| AND Gate (IC7408) | 1 |
| NOR Gate(IC7402) | 1 |
| JK Flip Flop(IC74112) | 2 |
| 4x1 MUX(IC74153) | 2 |
| NOT Gate(IC7404) | 1 |
| DC Motor(small) | 1 |
| Digital IC Trainer Kit | 1 |
| Battery(9V) | 1 |

| Componets | Quantity |
|---|---|
| 555 Timer (IC555) | 1 |
| 3x8 Decoder(IC74138) | 1 |
| Relay (5V) | 1 |
| Resistors (68KΩ, 39KΩ, 1KΩ) | 1,1,20 |
| Capacitors (10nF,100nF,1μF) | 2,1,1 |
| BJT(BC547) | 7 |
| LED's | 11 |
| Water tank (small) | 2 |
| Toggle Switches | 2 |
| Water Tube | 1 |

## Simulation



AND GATE : The AND gate is used as a level selector. It combines the inputs from the level selector switch and the automatic/manual switch. The output of the AND gate is used to control other parts of the circuit based on the selected water level.

NOR GATE : NOR gate is used to manage signals from the wires inside the tank and control the state of the water pump.

- The inputs to the NOR gate are the signals from the wires present inside the tank, indicating various water levels (25%, 35%, 50%, 75%, and 100%).
- The NOR gate might also receive inputs from the manual ON/OFF switch, depending on the specific design of the circuit.

JK FLIP FLOP : The JK flip-flop in this circuit acts as a bistable memory element that controls the state of the water pump relay based on the water level inputs and manual control settings.

It ensures that the pump operates only when necessary, based on the combined logic of the level selector, wires in the tank, and the timing mechanism.

By toggling its state, the flip-flop provides a robust and reliable way to maintain the desired water level in the tank, preventing overflow and ensuring efficient water usage.

4X1 MUX : A multiplexer selects one of many input signals and forwards the selected input into a single line.

In this circuit, the MUX selects the appropriate Wires in the tank signal based on control inputs, such as the automatic/manual switch and the level selector.

DECODER : A decoder takes a binary input and activates the corresponding output line.

In this circuit, the decoder is used to activate the appropriate wires inside the tank based on the selected water level.

NOT GATE : Not gate is used as a mediator between the Manual and Automatic switch.

555 TIMER : The 555 timer is configured as a monostable multivibrator. It provides a timed pulse when triggered by the output from the OR gate.

The timer's output pulse is used to control the relay, which in turn controls the water pump.

RELAY : The relay part receives signals from the 555 timer and the AND gate.

It acts as a switch to control the water pump, turning it on or off based on the signals it receives.

TOGGLE SWITCHES : The Toggle Switches are used in 2 places, one as a Manual and Automatic switch. The other as a manual on/off switch for the motor to turn on and off manually(when the 1st switch is in manual mode).

This switch allows manual control of the system, enabling or disabling the automatic water level control. When in the "OFF" position, it overrides the automatic control and turns off the water pump.

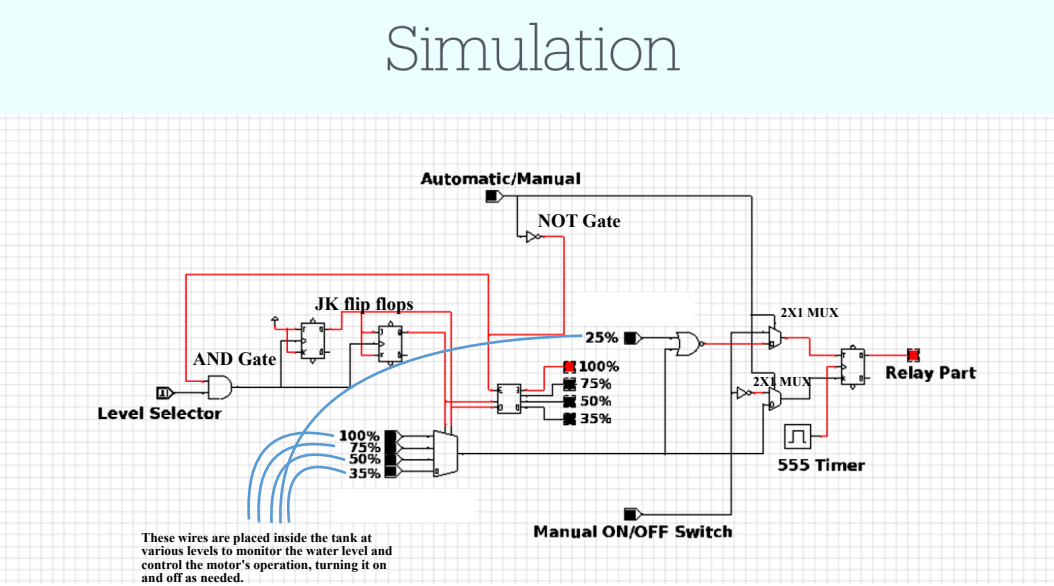
4. **Budget**:

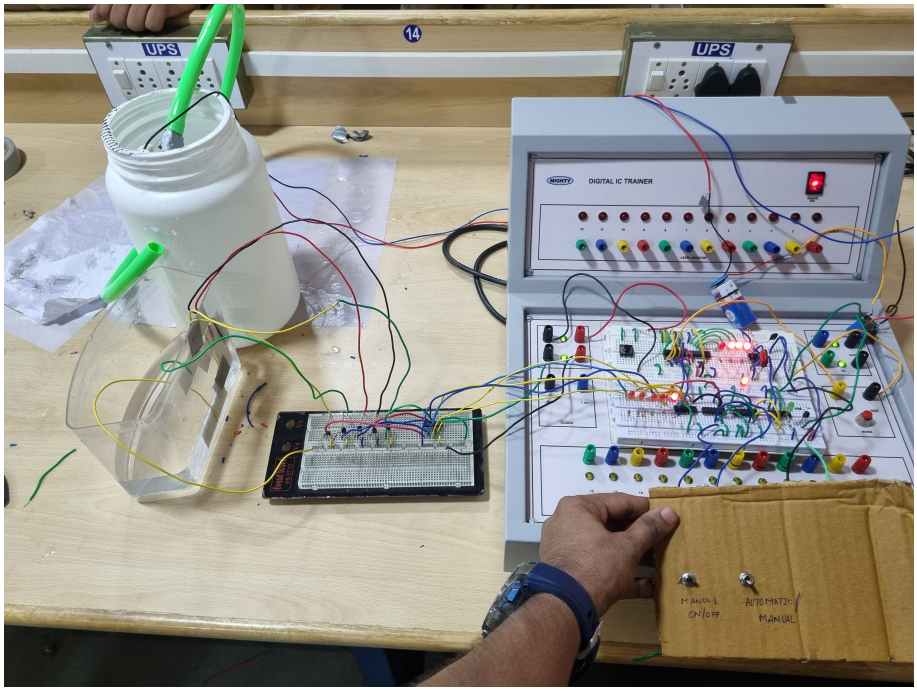
| Components | Cost |
|---|---|
| Bread board | ₹0(from lab) |
| Connecting Wires | ₹0(from lab) |
| AND Gate | ₹0(from lab) |
| NOR Gate | ₹0(from lab) |
| JK Flip Flop | ₹0(from lab) |
| 4X1 MUX | ₹0(from lab) |
| NOT Gate | ₹0(from lab) |
| Digital IC Trainer Kit | ₹0(from lab) |
| 555 Timer | ₹0(from lab) |
| 3x8 Decoder | ₹0(from lab) |
| Relay | ₹0(from lab) |

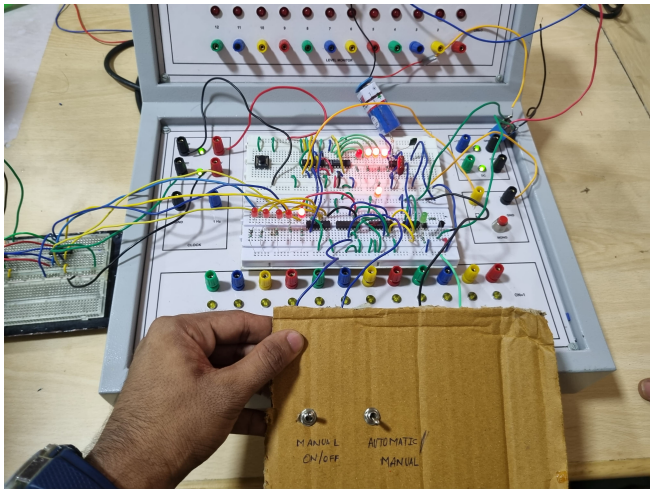
| Components | Cost |
|---|---|
| Resistors | ₹0(from lab) |
| Capacitors | ₹0(from lab) |
| BJT | ₹0(from lab) |
| 9V battery | ₹ 20 |
| Water Tank(small) - 2 | ₹ 80 (₹ 40 each) |
| Motor(small) + Tube | ₹ 70 |
| Toggle Switches - 2 | ₹ 30 (₹ 15 each) |

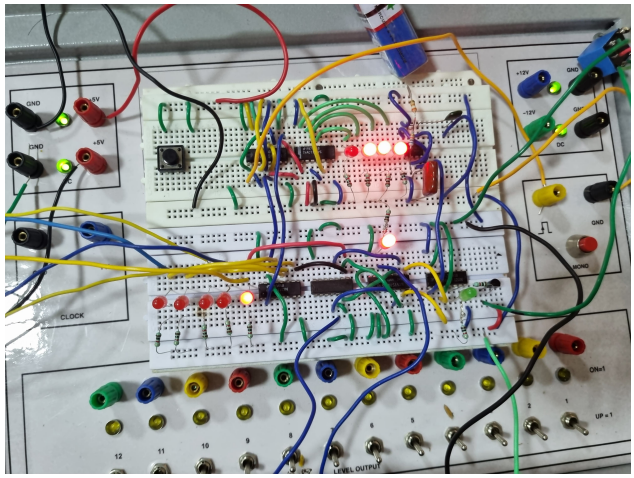
5. **Circuit Diagram / Board Layout / Schematic**:

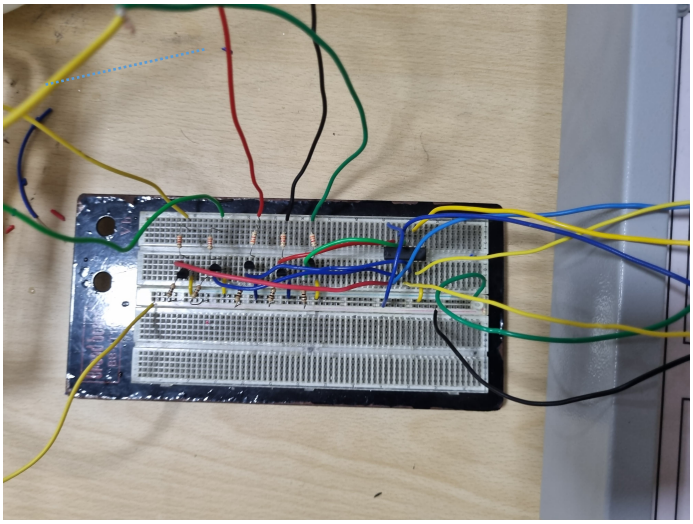
Circuit Diagram





6. **Simulation Results / Discussion**: Automatic Mode:

System accurately monitored water levels using water inside the tank at 25%, 35%, 50%, 75%, and 100%.

MUX selected the active signal from the wires in tank; OR gate triggered the 555 timer, which activated the relay to turn on the water pump.

At the designated level given by the user, the water in the tank signal gets deactivated preventing the pump to overflow.

Manual Control:

Manual ON/OFF switch allowed direct control over the water pump, bypassing automatic mode.

Provided flexibility for maintenance and specific user needs.

Relay and Timer:

The 555 timer provided consistent pulses to control the relay.

Relay accurately turned the water pump on and off based on timer signals, ensuring smooth operation.

**Discussion**

Efficiency: The system efficiently managed water levels, activating the pump as needed and preventing overflow.

Reliability: All components (MUX, decoder, gates, JK flip-flop, 555 timer) performed reliably.

Flexibility: Both automatic and manual modes offered flexibility for various scenarios.

7. **Implementation / Prototyping results**:

The implementation of the water level control system was successful, with the prototype demonstrating reliable and efficient operation.

The system effectively maintained water levels within the desired range, preventing both overflow and insufficient water levels.

Both automatic and manual modes worked as intended, providing flexibility and user control.

The combination of MUX, decoder, logic gates, JK flip-flop, 555 timer, and relay resulted in a robust and responsive water level control system.

8. **Discussion & Conclusions**:

**Discussion**

**System Efficiency:** The water level control system efficiently managed water levels, activating the pump only when necessary and preventing overflow.

**Component Reliability:** All components (MUX, decoder, logic gates, JK flip-flop, 555 timer, and relay) performed reliably, ensuring stable operation.

**Flexibility:** The inclusion of both automatic and manual modes provided flexibility, accommodating different user needs and scenarios.

**Response Time:** The system demonstrated prompt response times to water level changes, ensuring efficient water usage and protection against equipment damage.

**Scalability:** The design allows for easy scalability, modification of control logic if needed.

**Conclusion**

The implementation and testing of the water level control system were successful. The system effectively maintained optimal water levels, ensuring efficient water usage, preventing overflow, and protecting equipment. The combination of automatic and manual modes provided both reliability and flexibility. Overall, the prototype demonstrated that the design meets its intended objectives, making it a robust solution for water level management.