Design and Simulation of Water Level Detector using Transistors in eSim

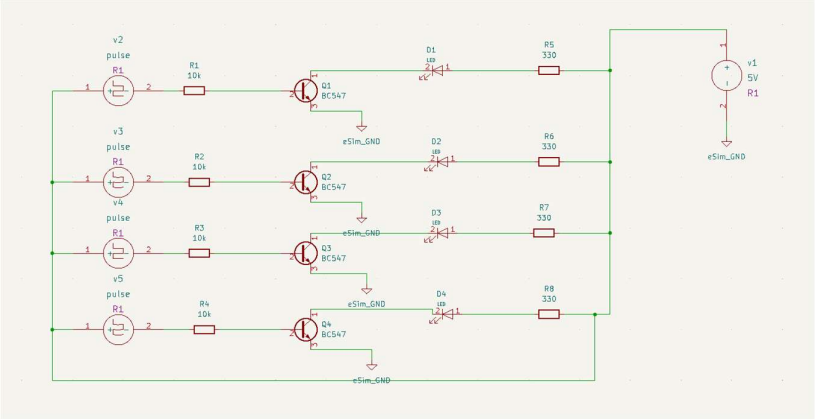
Introduction

Water level monitoring is important in domestic and industrial applications to prevent overflow and dry running of tanks. This project presents a simple and cost-effective water level detector using transistors as switches and LEDs as indicators. The system detects different water levels and provides visual indication for each level.

Problem Statement

To design and simulate a simple water level indicator circuit using a BJT transistor and analyze its switching behavior using transient analysis.

Circuit Diagram



Circuit Description

The circuit consists of an NPN transistor (BC547) used as a switch. A pulse voltage source is applied to the base to simulate the change in water level. An LED is connected at the collector to indicate the output state.

Components Used

- NPN Transistor (BC547)
- Resistor (10kΩ) – Base bias
- Resistor (330Ω) – LED current limiting
- LED
- DC Supply (Vcc)
- Pulse Voltage Source

Working Principle

When the input pulse is LOW (0V), the transistor remains in cut-off region and the LED is OFF. When the input pulse becomes HIGH (5V), the transistor enters saturation and the LED turns ON. Thus, the transistor acts as a switch and behaves as an inverter.

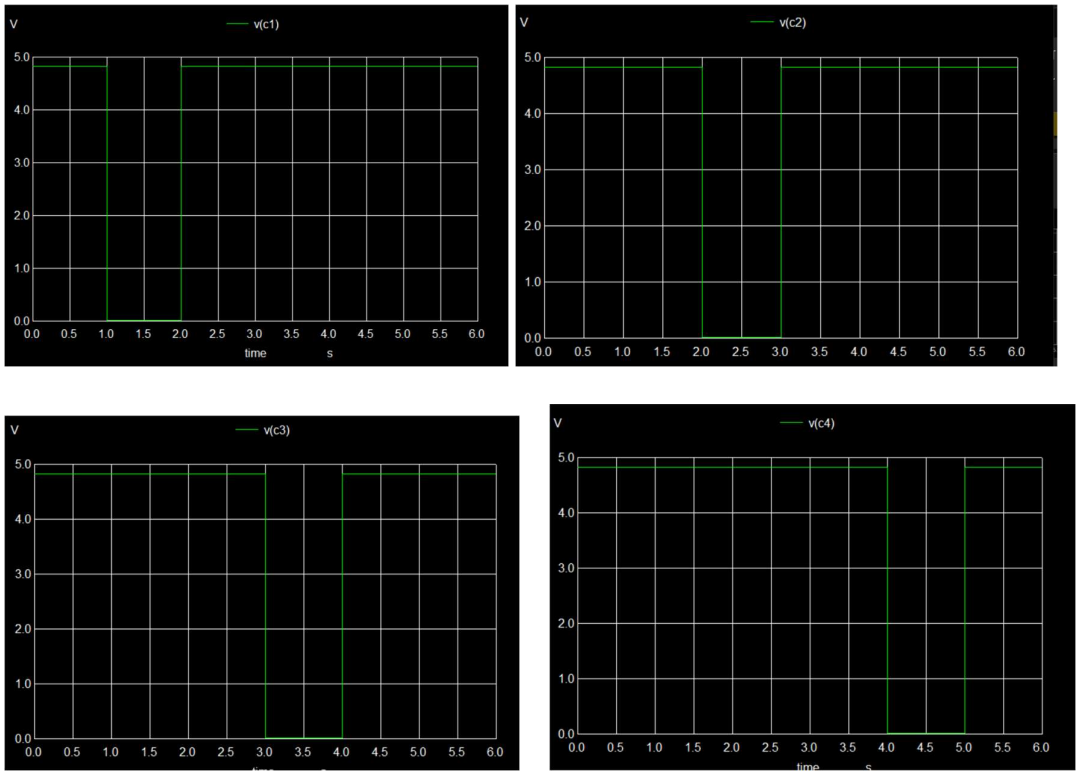
In this system, water conductivity is used to control the transistor. When the water level reaches a probe, it completes a conductive path and allows base current to flow, turning the transistor ON and lighting the LED. When the water is below the probe, no current flows, so the transistor remains OFF and the LED stays OFF.

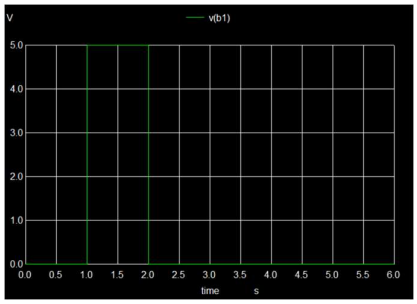
For multiple levels, several probes are placed at different heights, each connected to a transistor-LED pair. As the water level rises, LEDs turn ON sequentially, indicating the water level.

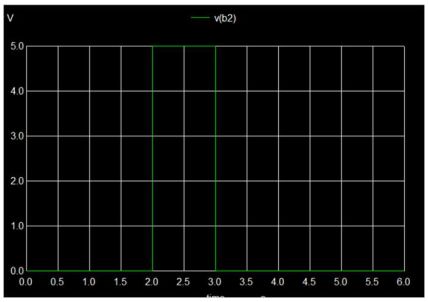
In the simulation, a pulse voltage source represents water contact, where LOW indicates no water and HIGH indicates water presence.

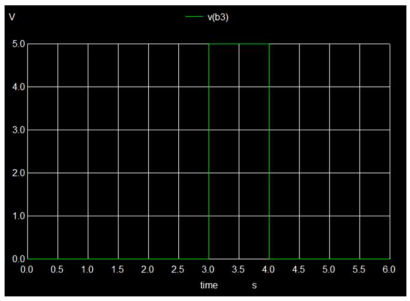
RESULTS:

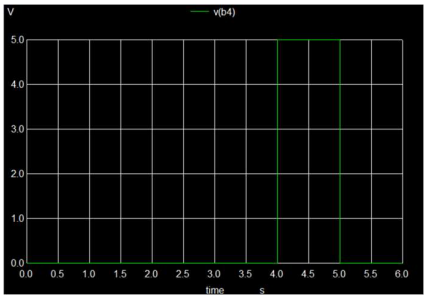
1. Transient plot











Observations :

The transient response shows that when the input is LOW, the transistor is OFF and collector voltage is HIGH. When input becomes HIGH, the transistor turns ON and collector voltage drops. The output is an inverted version of input.

- From 0 to 1 second:
  - Input = 0V → Transistor OFF
  - Collector voltage = HIGH
- At 1 second:
  - Input rises to 5V → Transistor ON
  - Collector voltage drops sharply
- After pulse duration:
  - Input returns LOW → Transistor OFF
  - Collector voltage rises again

Graph Interpretation :

- The input waveform (Base voltage) is a pulse signal.
- The output waveform (Collector voltage) is an inverted version of the input.

Key Insight:

- When input goes HIGH → output goes LOW
- When input goes LOW → output goes HIGH

This confirms that the circuit behaves as a **NOT gate (inverter)**.

CONCLUSION:

The simulation successfully demonstrates the operation of a transistor as a switch. The collector output shows an inverted response to the input pulse, validating the working of the circuit as a water level indicator and a basic digital inverter.