Title of the experiment:

Circuit-Level Gas Detection and Threshold Alert System Using LM393 Comparator

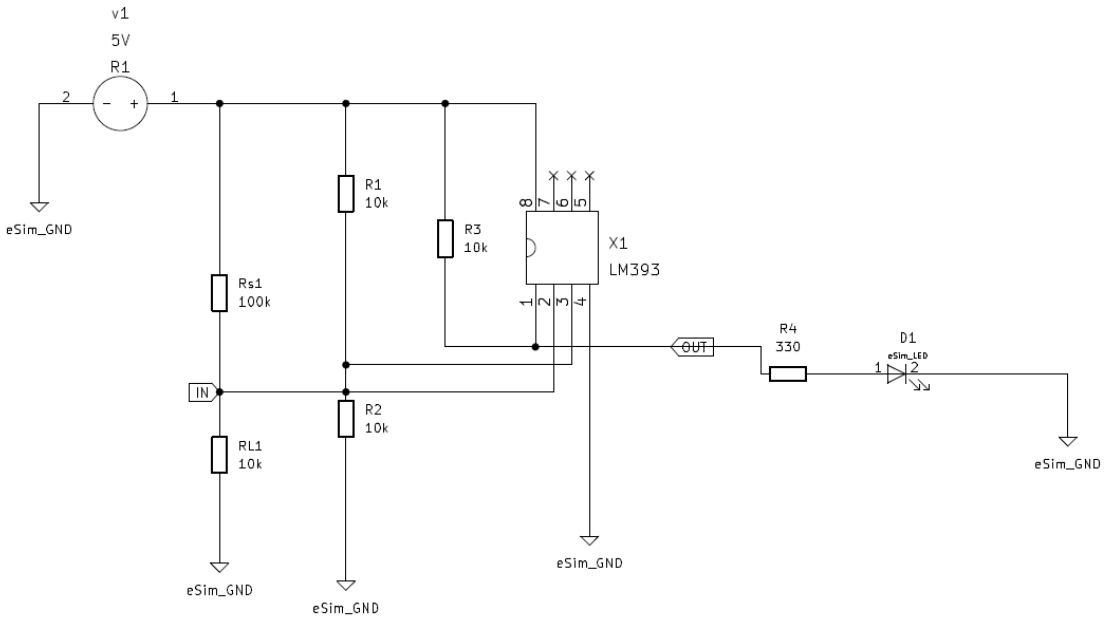
Theory:

The circuit operates on the principle of resistive gas sensing and voltage comparison. A variable resistance models the gas sensor, producing a voltage proportional to gas concentration through a voltage divider. This sensor voltage is compared with a fixed reference voltage using an LM393 comparator. Based on the comparison, the comparator switches its output state to indicate whether the sensed gas level crosses a predefined threshold.

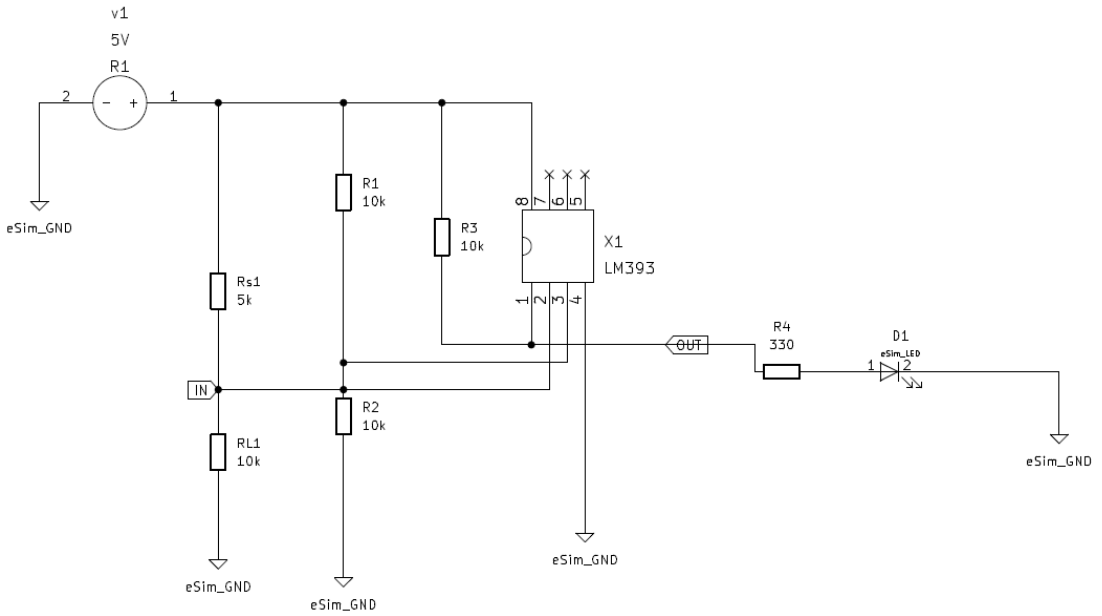
Schematic Diagram:

The schematic consists of a resistive gas sensor model, a reference voltage divider, an LM393 comparator, a pull-up resistor, and an LED indicator. The sensor output is connected to the inverting input, while the reference voltage is applied to the non-inverting input of the comparator to ensure correct detection logic.

No gas present:



Gas is present:

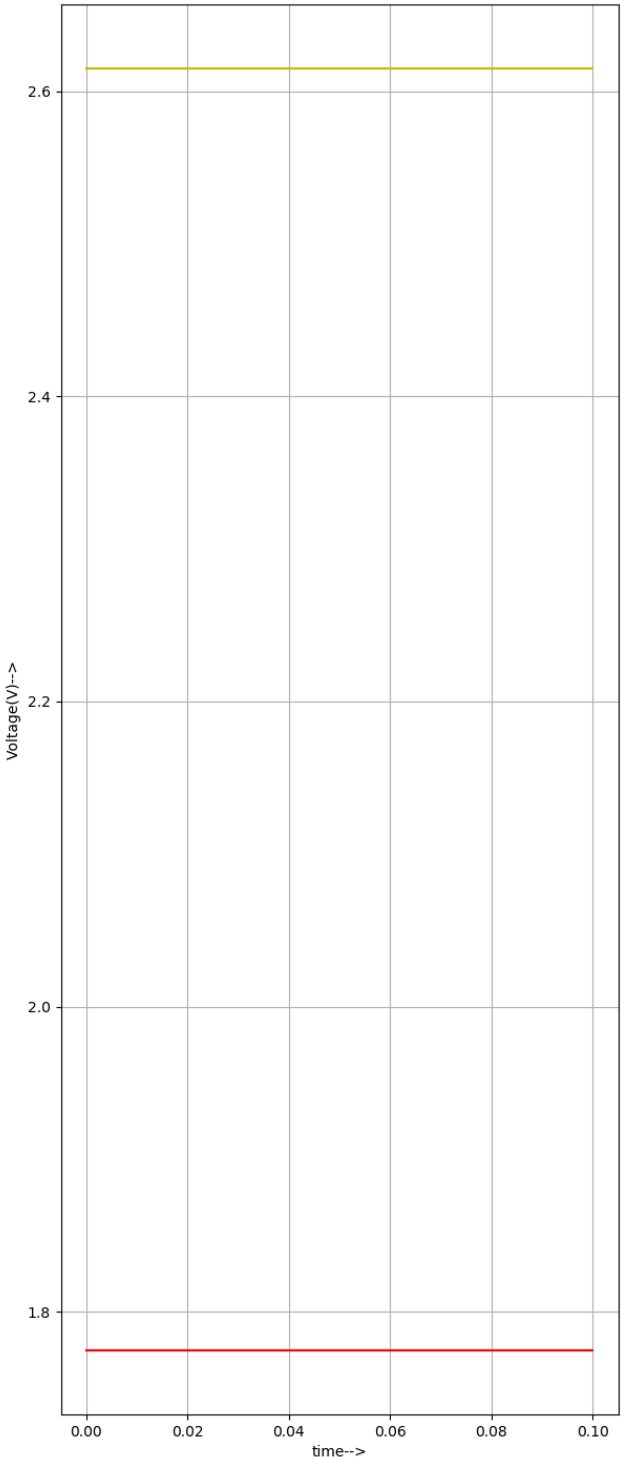


Simulation Results :

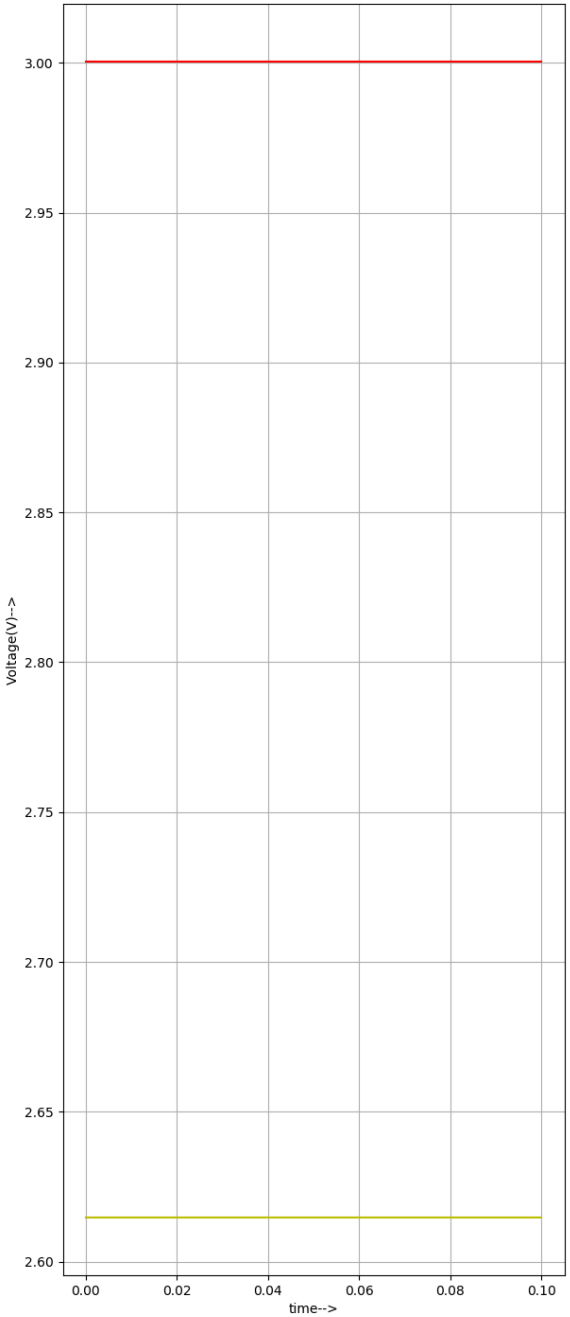
Transient analysis was performed by varying the sensor resistance to simulate different gas concentrations. For high resistance values representing clean air, the sensor voltage remained below the reference voltage and the LED stayed OFF. As the resistance decreased, the sensor voltage increased and exceeded the reference voltage, causing the comparator to activate and the LED to turn ON.

Python Plots:

No gas present:


2.6
2.4
2.2
2.0
1.8
Voltage(V)-->
0.00
0.02
0.04
0.06
0.08
0.10
time-->

Gas is present:



Case	Sensor Resistance	Sensor Voltage (Vout)	Reference Voltage (Vref)	Comparator condition	LED State
1	100 kΩ	≈ 1.8 V	≈ 2.5 V	Vout < Vref	OFF
2	5 kΩ	≈ 3.0 V	≈ 2.5 V	Vout > Vref	ON

Conclusion :

The designed circuit successfully demonstrates threshold-based gas detection using a resistive sensor model and an LM393 comparator. By applying the sensor voltage to the inverting input and the reference voltage to the non-inverting input, correct switching behavior is achieved, ensuring the LED activates only when the gas concentration exceeds the defined threshold.

References :

LM393 Comparator Datasheet