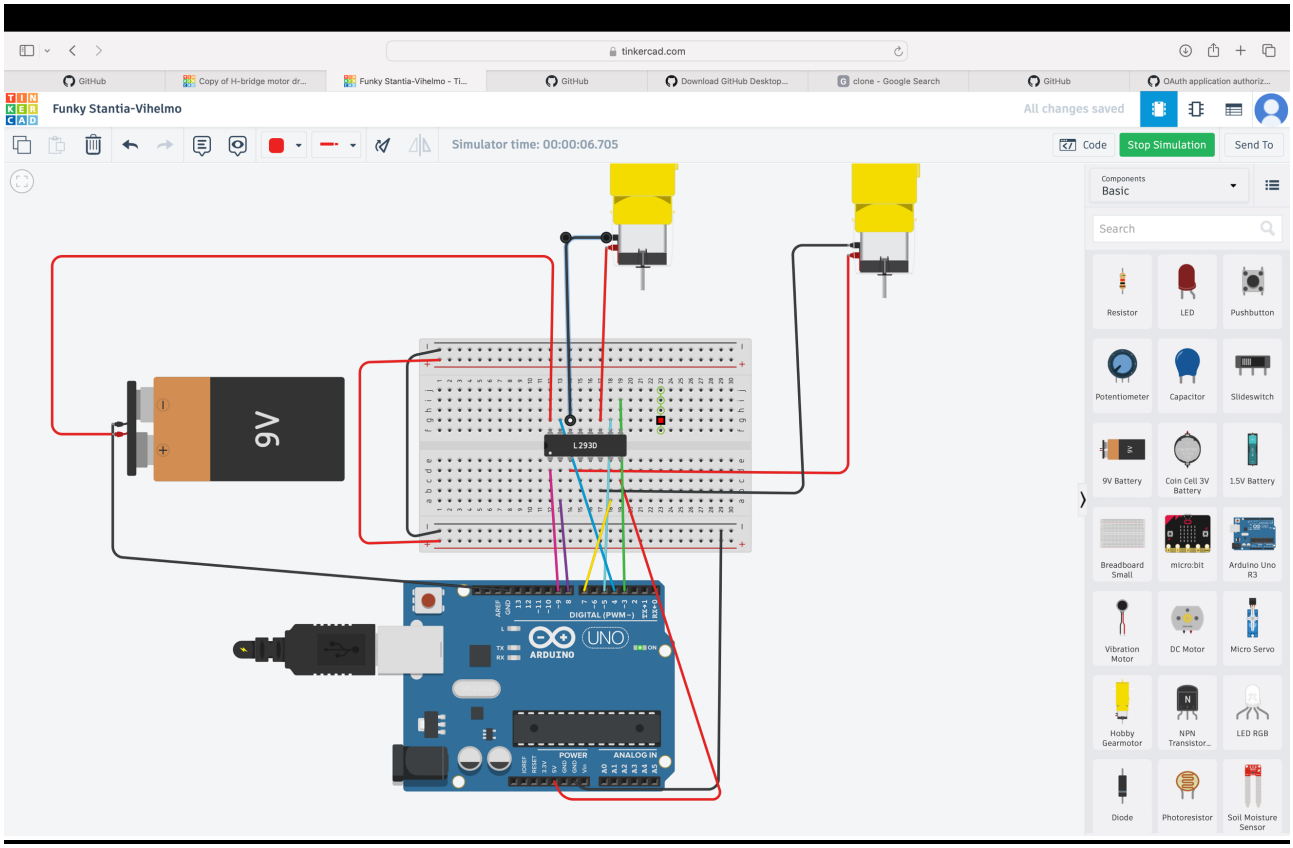
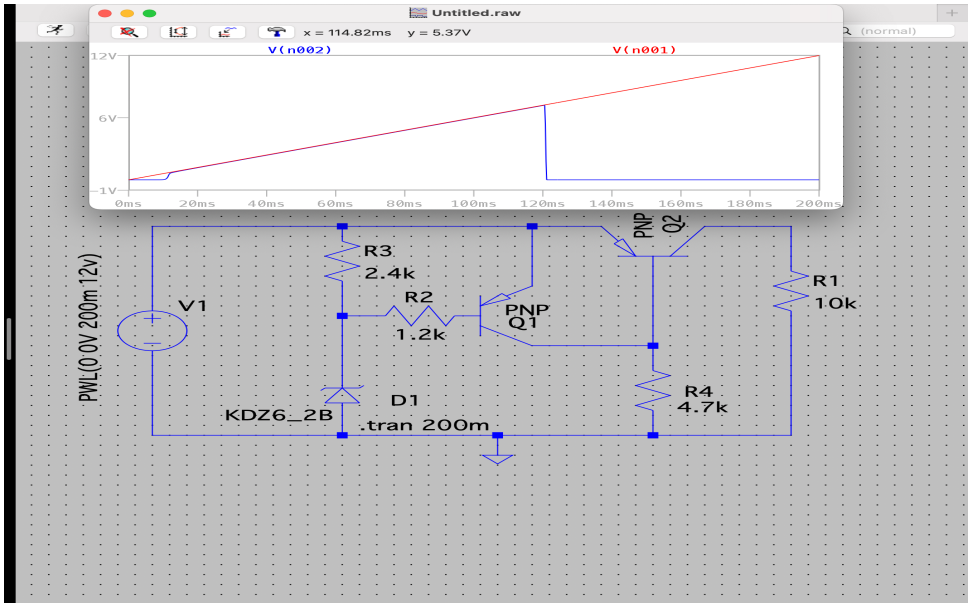
Task1: H-bridge:



An **H-bridge circuit** is an electronic switching circuit commonly used to control the direction of a DC motor. It is called an "H-bridge" because its schematic resembles the letter **H**, with the motor connected in the center as the horizontal bar and four switches or transistors forming the sides. By selectively closing two switches at opposite corners, current can flow through the motor in one direction (forward) or the opposite direction (reverse). If all switches are open, the motor stops (coasting), and if the motor terminals are shorted by closing the same-side switches, it quickly brakes. This makes the H-bridge a versatile circuit for applications such as robotics, automation, and motor-driven systems, often combined with PWM signals for precise speed and direction control.

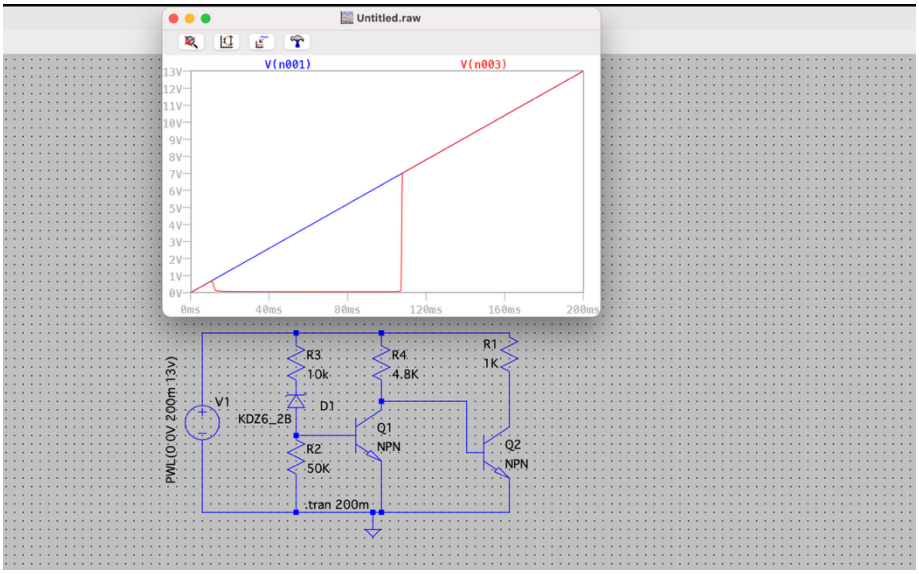
Task 2:Pnp overvoltage protection circuit:



Explanation:

The PNP-based overvoltage protection circuit is a series-pass limiter. The input supply passes through a PNP transistor to the load. The base of the PNP is referenced against a Zener diode. When the input exceeds the Zener threshold, the transistor restricts conduction and clamps the output voltage. This results in an output voltage nearly equal to Vz - 0.7 V. In simulation, the output voltage stabilized at 4.9–5.0 V even when the input had risen to 12 V. Power is dissipated by the PNP transistor as it shorts out the excess voltage.

Npn overvoltage protection circuit:



Explanation:

The NPN-based overvoltage protection circuit works as a shunt clamp. The protected node is connected to the collector of an NPN transistor. The base is biased by a Zener diode and a resistor, so when the node voltage exceeds Vz + 0.7 V, the transistor turns on and shunts excess current to ground. This clamps the node at around 6.2–6.4 V. The simulation shows that the output stays at 0 V while the input increases from 0 V up to about 6.2 V, because the Zener diode and transistors are off. Once the input exceeds the Zener threshold, the diode conducts, turning on Q1 and Q2, which causes the output to quickly rise and then follow the input voltage. This confirms the circuit works as an overvoltage protection circuit: blocking the output at low voltages and allowing it through only above the set threshold.

Comparison and Differences:

The two circuits operate differently but both provide overvoltage protection:

- The NPN circuit is a shunt clamp, clamping at approximately Vz + 0.7 V (~6.3 V). It is fast and simple but dissipates current while clamping.
- The PNP circuit is a series-pass limiter, clamping at approximately Vz - 0.7 V (~4.9 V). It prevents excess voltage from reaching the load but dissipates power in the transistor.

In summary, the NPN is suitable for protecting signal inputs and logic pins, while the PNP is better suited for regulating power lines to keep voltages within safe limits.