EE430 Electromagnetism
Project 5: Electric Field Strength Meter
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- Cameron deLeeuw

Circuit Schematic:

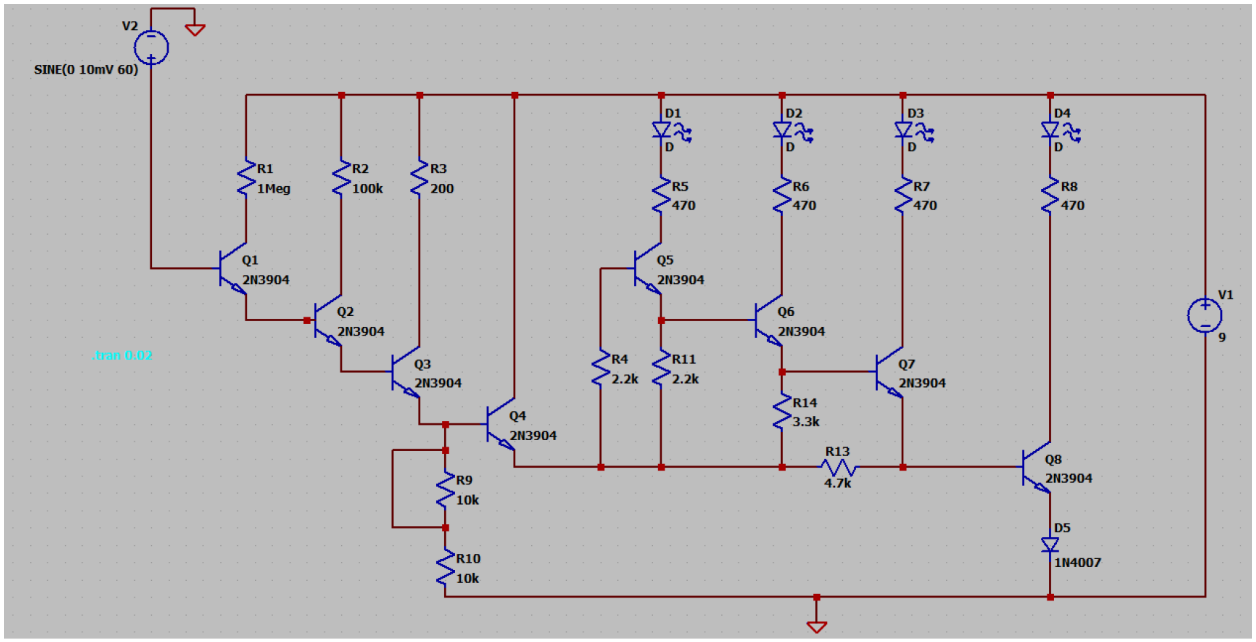

Fig.1

LTSpice Simulation:

- LED Currents with R10 = 1kΩ:
  - I_D1 = 8.3 pA
  - I_D2 = 8.3 pA
  - I_D3 = 8.3 pA
  - I_D4 = 10.4 nA
- LED Currents with R10 = 10kΩ:
  - I_D1 = 8.4 pA
  - I_D2 = 8.4 pA
  - I_D3 = 8.4 pA
  - I_D4 = 10.5 nA
- LED Currents with R10 = 19kΩ:
  - I_D1 = 8.4 pA
  - I_D2 = 8.4 pA
  - I_D3 = 8.4 pA
  - I_D4 = 10.5 nA

Annotated Photo of the Implemented Circuit:

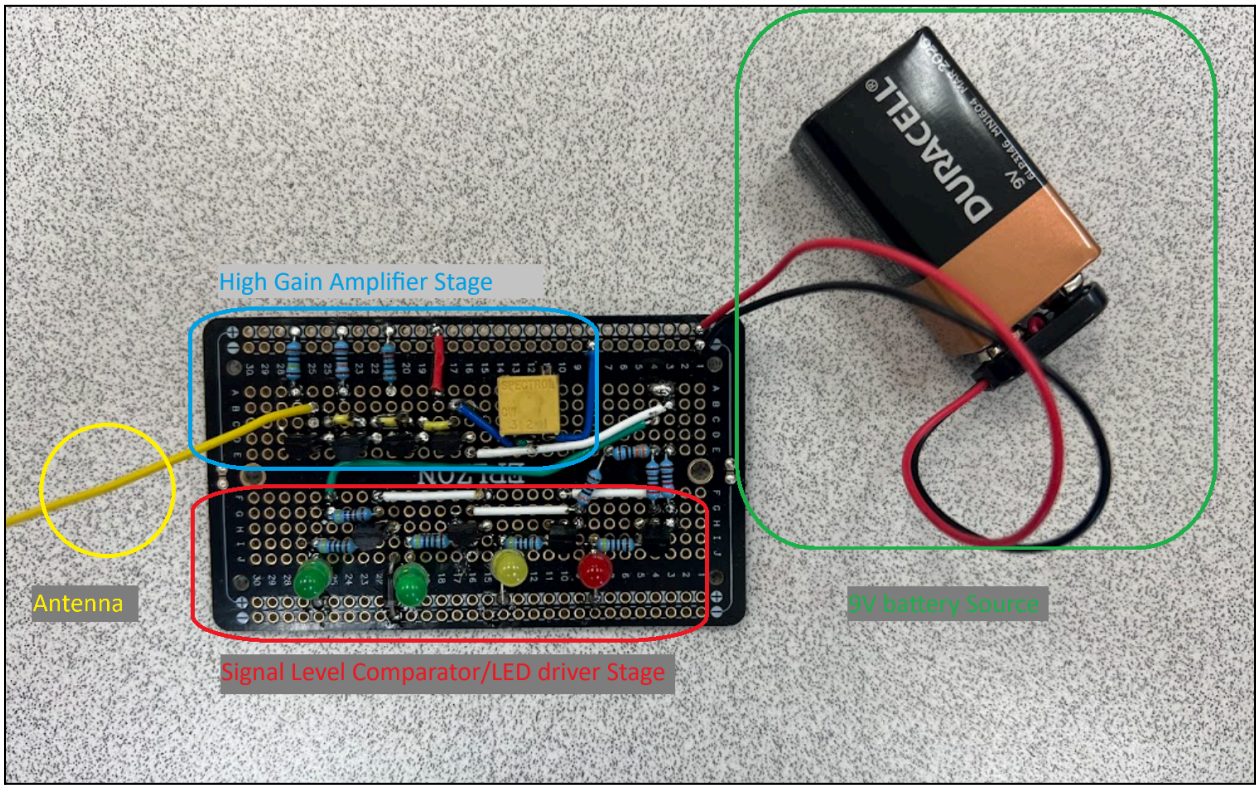

Fig.2

Measurement Results:

Currents through R5, R7, R10 and R11

- I_R5 = ~0 A
- I_R7 = ~0 A
- I_R10 = ~0 A
- I_R11 = ~0 A

Questions & Considerations:

- How does the circuit detect the electric field strength?
  - The circuit detects electric field strength by using an antenna to capture ambient RF signals, which are then amplified and rectified into a DC voltage that drives LED indicators based on signal intensity.
- How does the circuit indicate the relative field strength?
  - The circuit indicates relative field strength by lighting up a series of LEDs each driven by a transistor that turns on at increasing voltage thresholds so more LEDs light up as the detected signal gets stronger.
- What are the conditions needed to turn on each one of the LEDs?

    - Each LED turns on when the amplified RF signal voltage exceeds the specific base-emitter threshold of its corresponding transistor, determined by a resistor network that sets increasing voltage levels for each stage.
- How does the potentiometer VR1 control the sensitivity of the circuit?
    - The potentiometer VR1 controls the sensitivity of the circuit by adjusting the biasing of the amplifier stages, thereby setting the minimum RF signal strength required to trigger the LED indicators.
- How would you change the circuit to increase its sensitivity to atmospheric phenomena?
    - Increasing the gain of the antenna could increase the circuit's sensitivity to atmospheric phenomena.
- How does the circuit performance change when you touch the ground node?
    - It seems unchanged, although this might be related to the length of the antenna, $\lambda/4$ wave antennas require a ground plane.