ISIM Lab 4: Humidity Sensor

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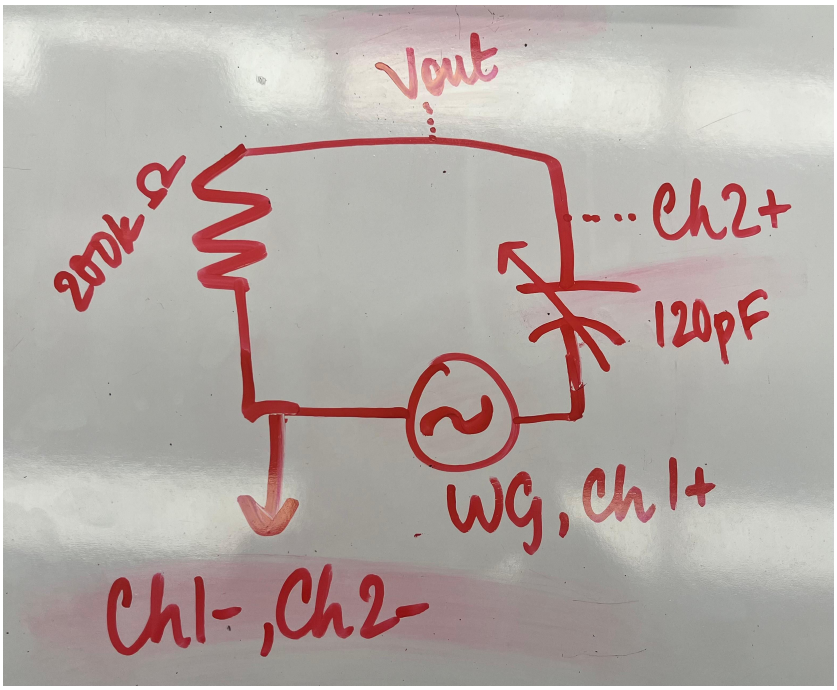
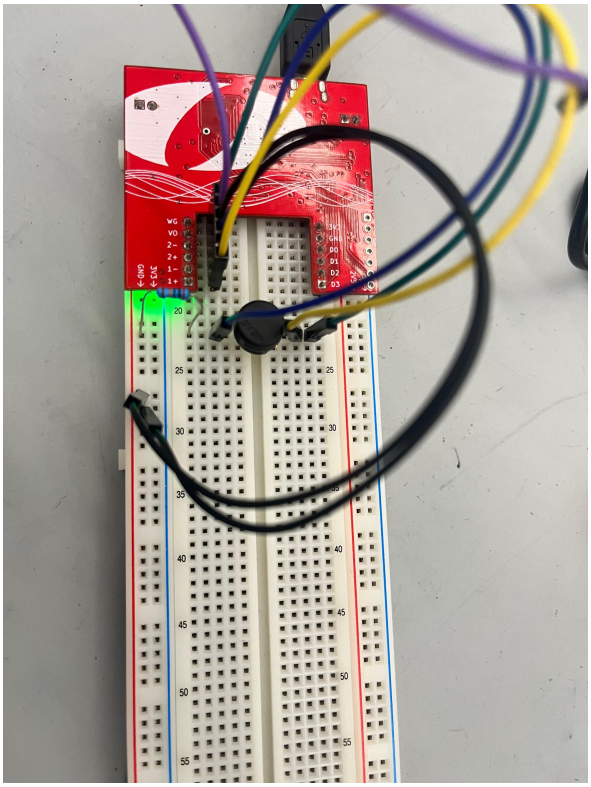
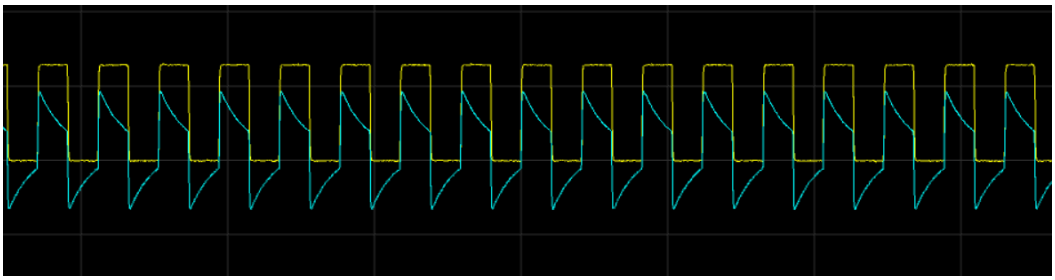
Circuit Diagram:



O-Scope Connections:



Cycles of Capacitor Voltage Response:



The screenshot displays a couple cycles to illustrate the capacitor voltage response from a CR circuit where resistance is 200k ohms and capacitance is 120pF.

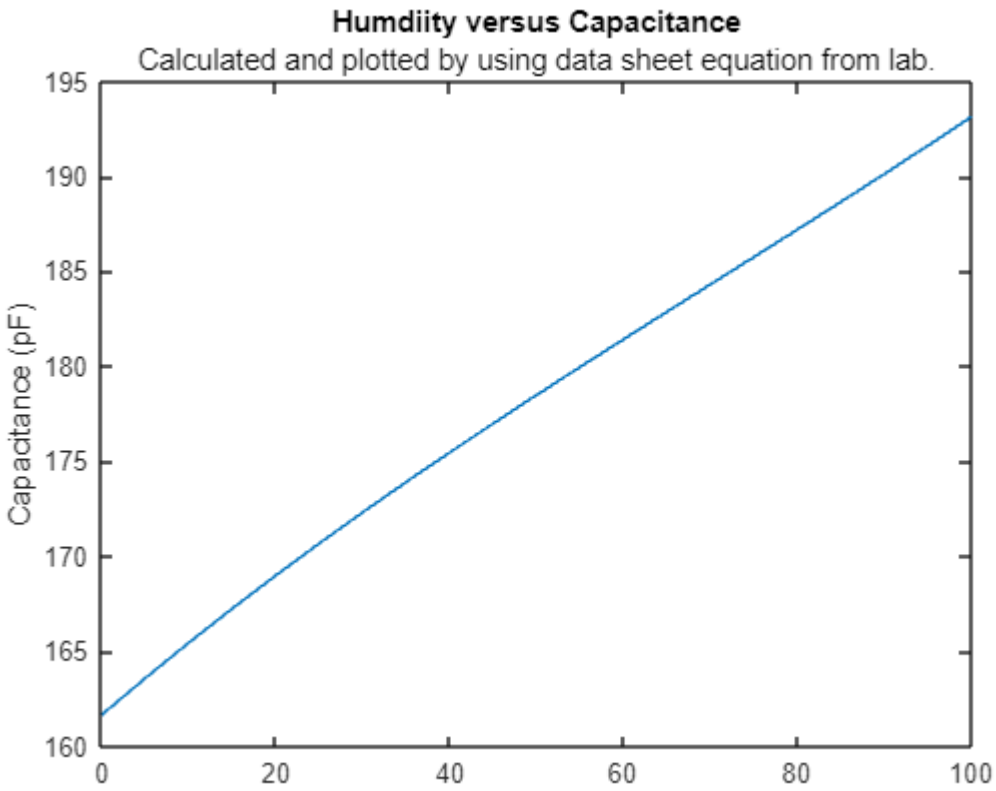
Capacitance versus Voltage RMS:

```
syms C RH;

RH= 0:5:100;
C= 180*(3.908*(10^-8).*(RH.^3) - 8.294*(10^-6).*(RH.^2) + 2.188*(10^-3).*RH +
0.898);

figure()
plot(RH, C)
xlabel=('Humidity (%)');
ylabel('Capacitance (pF)');
```

```
title('Humdiity versus Capacitance')
subtitle('Calculated and plotted by using data sheet equation from lab.')
```

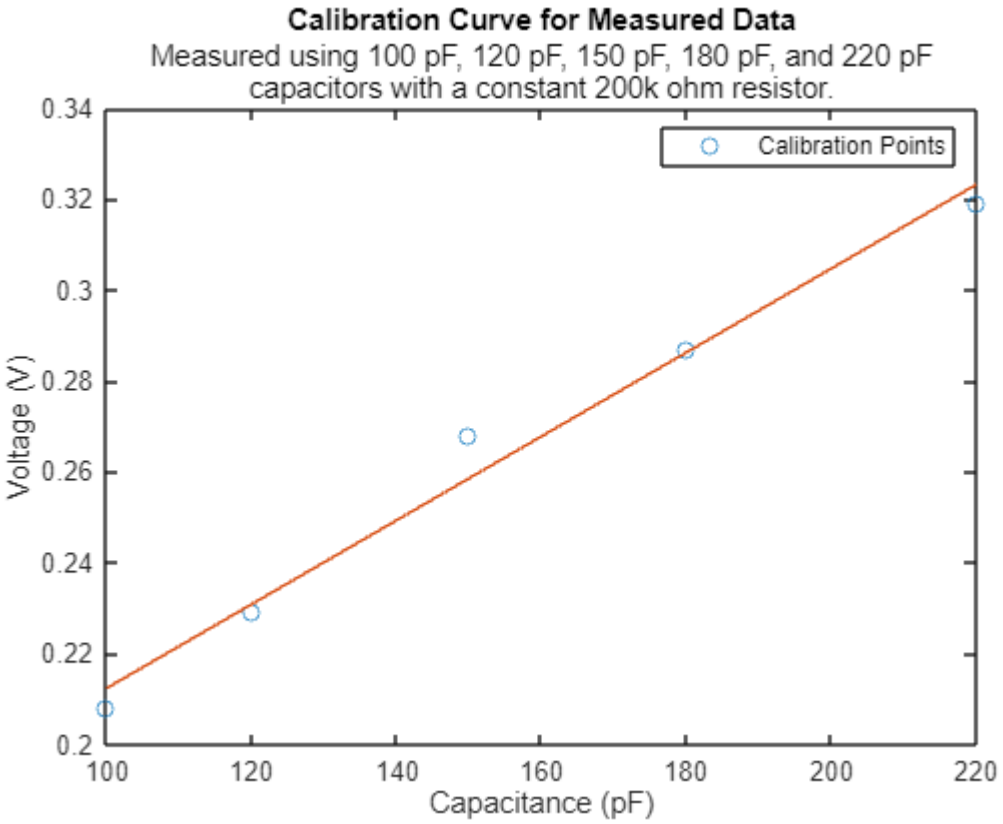



```
cap = [100, 120, 150, 180, 220];
voltage = [0.208, 0.229, 0.268, 0.287, 0.319];

coefficients = polyfit(cap, voltage, 1);
a = coefficients(1);
b = coefficients(2);

voltage_fit = polyval(coefficients, cap);

figure()
plot(cap, voltage, 'o'); hold on
plot(cap, voltage_fit);
clear xlabel;
xlabel('Capacitance (pF)');
ylabel('Voltage (V)');
title('Calibration Curve for Measured Data')
subtitle({'Measured using 100 pF, 120 pF, 150 pF, 180 pF, and 220 pF', 'capacitors
with a constant 200k ohm resistor.'});
legend('Calibration Points')
```




```
syms C V

eqn = V == coefficients(1)*C + coefficients(2)
```

```
eqn =
```

$$V = \frac{8521505787559027\,C}{9223372036854775808} + \frac{4320532253043877}{36028797018963968}$$

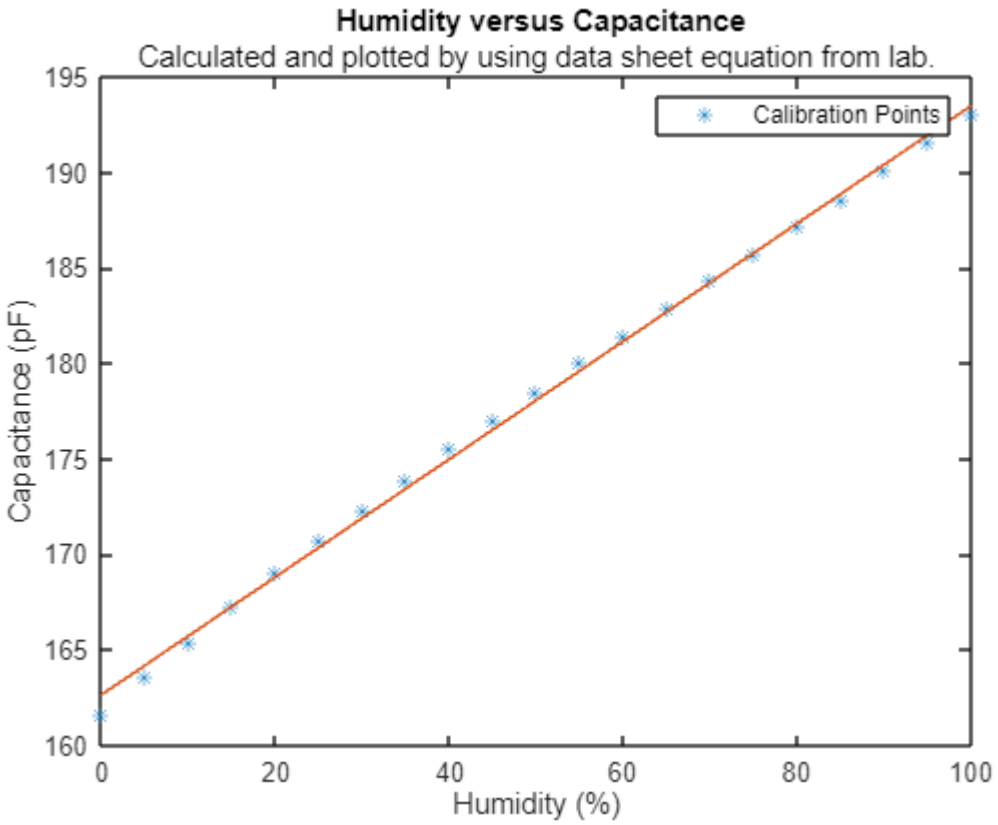
```
cap2 = [161.6, 163.6, 165.4, 167.2, 169, 170.7, 172.3, 173.9, 175.5, 177, 178.5,
180, 181.4, 182.9, 184.3, 185.7, 187.2, 188.6, 190.1, 191.6, 193.1];
RH = 0:5:100;

coefficients = polyfit(RH, cap2, 1);
a = coefficients(1);
b = coefficients(2);

Capacitance_fit = polyval(coefficients, Rh);

figure()
plot(Rh, cap2, '*'); hold on
plot(Rh, Capacitance_fit);
xlabel('Humidity (%)');
ylabel('Capacitance (pF)');
title(' Humidity versus Capacitance')
subtitle('Calculated and plotted by using data sheet equation from lab.');
```

```
legend('Calibration Points')
```




```
syms C1 RH

eqn1 = C1 == coefficients(1)*RH + coefficients(2)
```

```
eqn1 =
```

$$C_1 = \frac{5157115345991267\,\mathrm{RH}}{18446744073709551616} + \frac{3917354619321601}{4503599627370496}$$

```
Voltage = (8353624235133817/92233720368547758O8)*((2971*RH)/(9625) + 26836/165) +
32947/45600
```

```
Voltage =
```

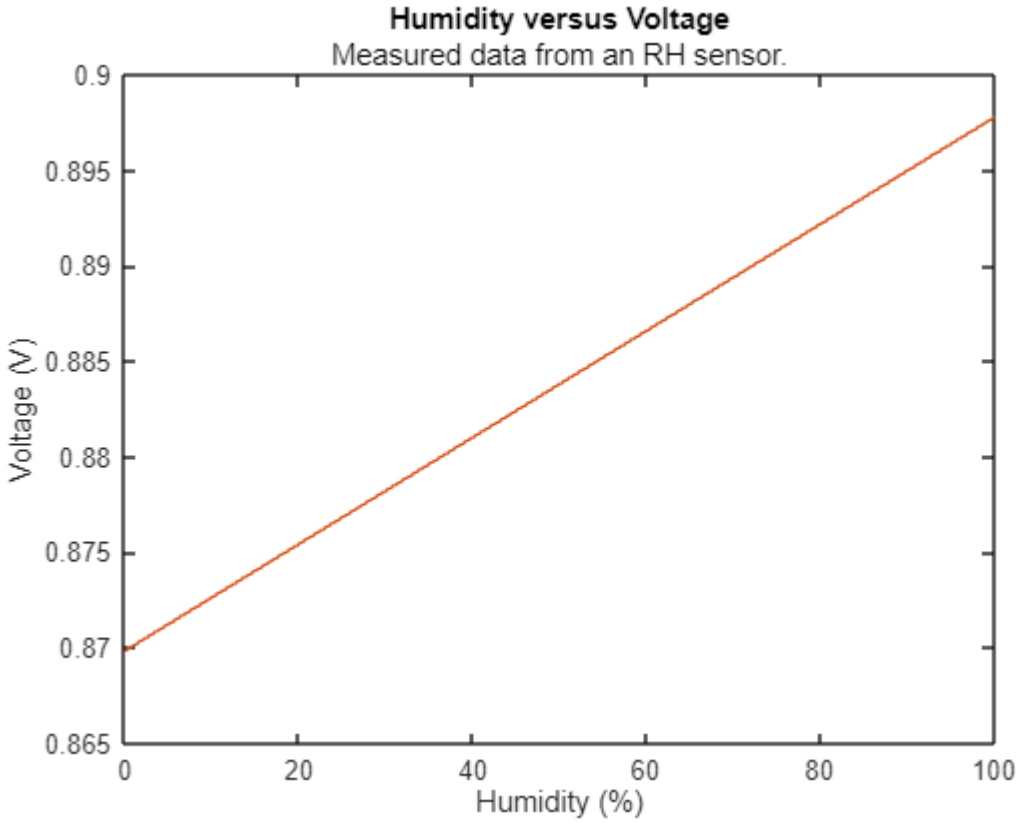
$$\frac{24818617602582570307\,\mathrm{RH}}{8877495585472721715200O} + \frac{31439121232827442715347}{36144089169424652697600}$$

```
RH_values = 0:5:100;
V = double(subs(Voltage, RH, RH_values));

coefficients = polyfit(RH_values, V, 1);
a = coefficients(1);
b = coefficients(2);

V_fit = polyval(coefficients, RH_values);
```

```
figure()
plot(RH_values, V); hold on
plot(RH_values, V_fit);
xlabel('Humidity (%)');
ylabel('Voltage (V)');
title('Humidity versus Voltage')
subtitle('Measured data from an RH sensor.');
```




```
syms Voltage

eqn2 = Voltage == (8353624235133817/9223372036854775808)*((2971*RH)/(9625) +
26836/165) + 32947/45600;
humidity = solve(eqn2, RH)
```

```
humidity =
```

$$\frac{8877495585472721715200 0\,\mathrm{Voltage}}{24818617602582570307} - \frac{9364844622544344638614 0}{30099174539302266117}$$

```
humidity_final = double(subs(humidity, Voltage, 0.892))
```

```
humidity_final = 79.3101
```

Conclusion:

The humidity is 52% today, but my results are about 79%. This result is far away from reality, meaning there must have been some factors that caused insufficient accuracy. The RH sensor might have off slightly and the

circuit might have been constructed with errors, thus failure to simulate perfect results. So, it is reasonable that there might have been an error in the final conclusions for this lab, but I tried!