THE UNIVERSITY OF TEXAS AT ARLINGTON

COMPUTER SCIENCE AND ENGINEERING

MECHATRONICS
LAB 5 REPORT

ELECTROMECHANICAL SYSTEMS & SENSORS

Submitted toward the partial completion of the requirements for CSE 5355-001

Submitted by,

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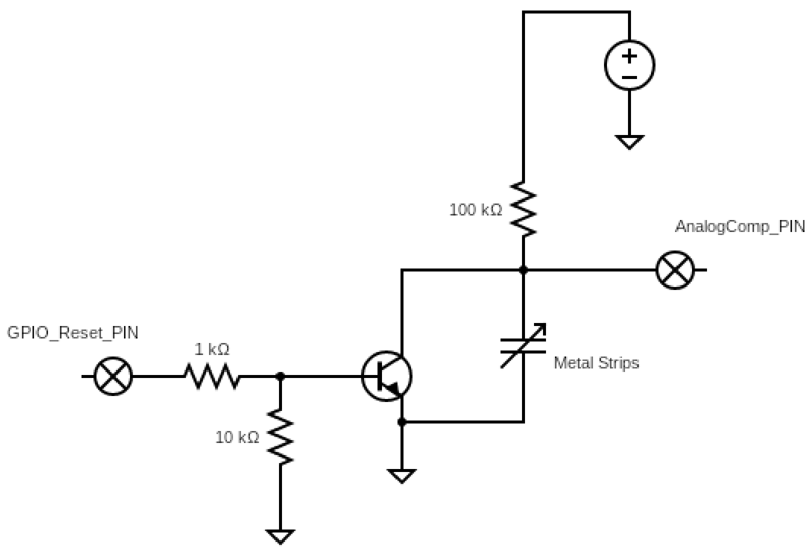
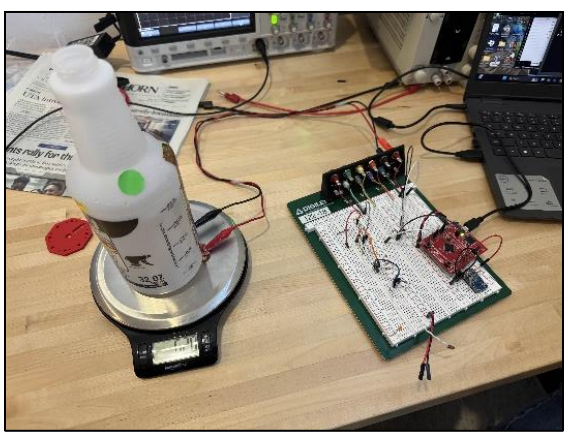
1. **Using a one of the provided plastic containers, attach electrodes on the outside of the container to form a capacitor that is used to measure liquid level. Build an integrator circuit that consists of a resistor from 3.3V to the capacitor (Vcap node). The other end of the capacitor is grounded. Add a transistor to deintegrate the charge in the capacitor under software control as shown in class. Connect Vcap to the input of the controller comparator 0 (C0-) and configure the internal reference to drive C0+ (Vref).**

Circuit Diagram



Built Circuit



Readings

2. **Write code to de-integrate the charge by turning on the transistor briefly and then measuring the time until the comparator changes state (Vcap > Vref). Empirically determine how to convert the time to mL of water in the container.**

   The capacitive circuit is connected to an analog comparator pin on the redboard. This pin triggers an interrupt when the Vcap > Vref. The frequency of this interrupt is limited by a 1 second periodic timer to reduce the data sampling rate. This timer de-integrates the charge by turning on the transistor for 100 microseconds. It then resets a free running timer that increments its count until the comparator interrupt is triggered. This counter then corresponds the time required to create Vref across the capacitor.

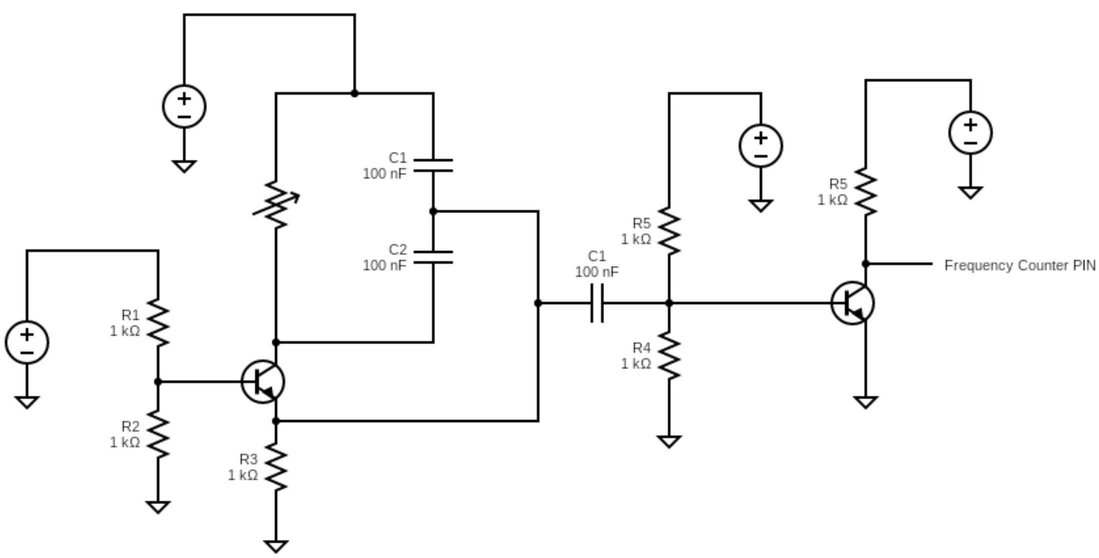
   Since there is a linear relationship between the water level and the time required to create Vref across the capacitor, various sample data were taken to create the following formula:

   waterLvl = 2.8298*(timer1Val) - 1236.7

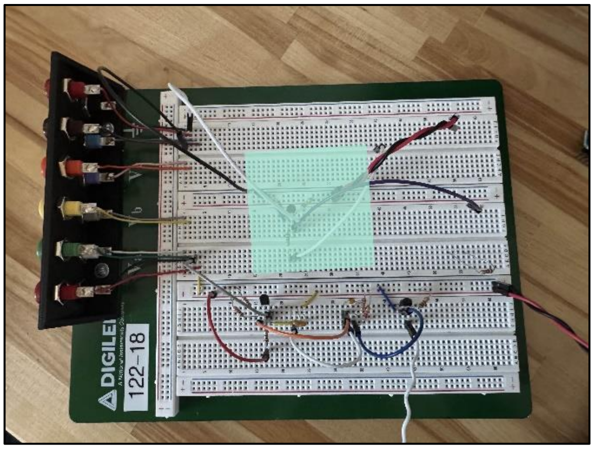
   This formula was then used to convert the free running timer value into a water level in mL.

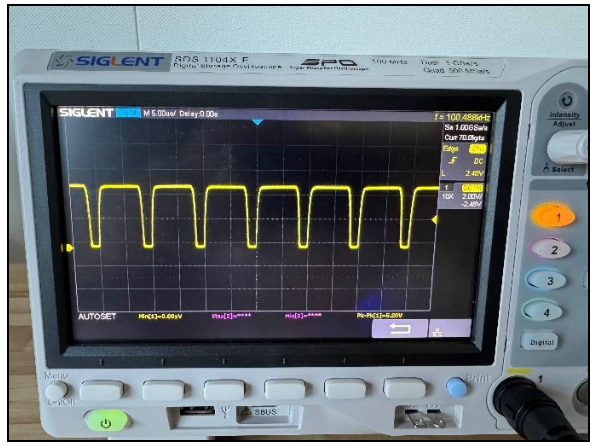
3. **Build a metal detector circuit using a large loop of wire and a Colpitts oscillator connected to the WT1CCP0 input. Place metal over the loop and note the change in frequency resulting from the eddy currents in the metal and the resulting change in inductance.**

Circuit Diagram



Built Circuit **Readings**





4. Write code to determine the average frequency of the loop. When the metal is brought near to the coil (similar to a car riding over the inductive loop at a traffic intersection), pulse an LED on briefly show that metal is detected.

For part 2 of the lab, logic was implemented in code to detect three different metals based on corresponding frequency ranges and feedback was provided using three LEDs (Red, Blue, & Green). Pin PC6 (WT1CCP0 timer) was connected to the frequency detection circuit to obtain the measured frequency, and a Wide Timer was configured to 1sec periodic to store the frequency (tick variable) and rese it. This frequency value was constantly printed out to putty and by placing the loop on three different metals (chair, power supply, & monitor) the respective ranges for each metal were determined. This step took a bit of data gathering, testing and tweaking. Finally, in the main loop the frequency is compared every second against the predefined ranges to identify the metal type, and based on the matched range the corresponding LED is turned on.

METAL EXAMPLE	**PICTURE**

Voltage Supply
(Blue LED)