RIDE HEIGHT CONTROL FOR SELF-LEVELING AIR SUSPENSIONS

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SENIOR CAPSTONE PROJECT | ECE-499

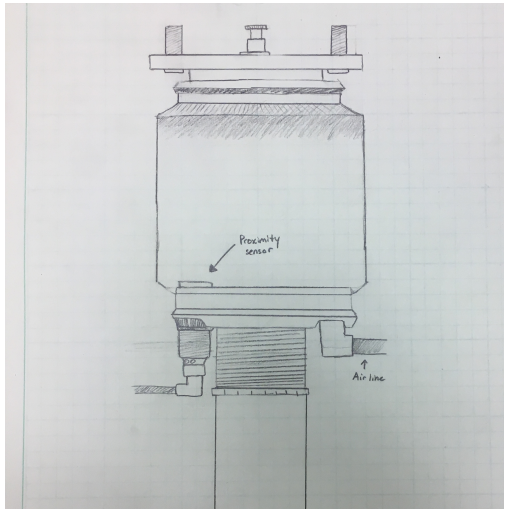
CURRENT METHODS ARE FLAWED

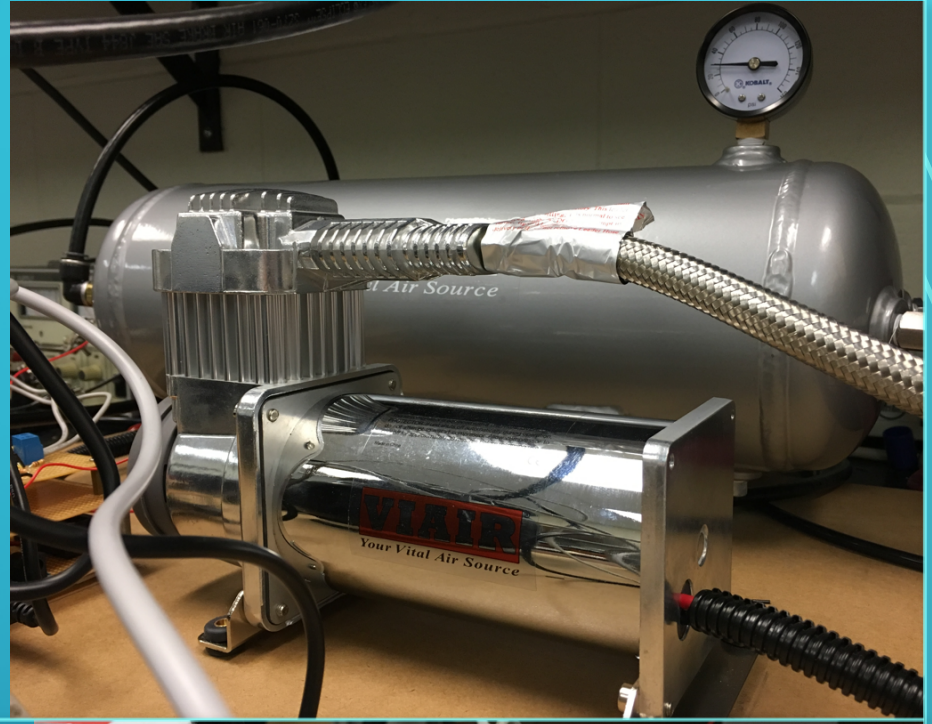
GOALS AND RESEARCH QUESTIONS

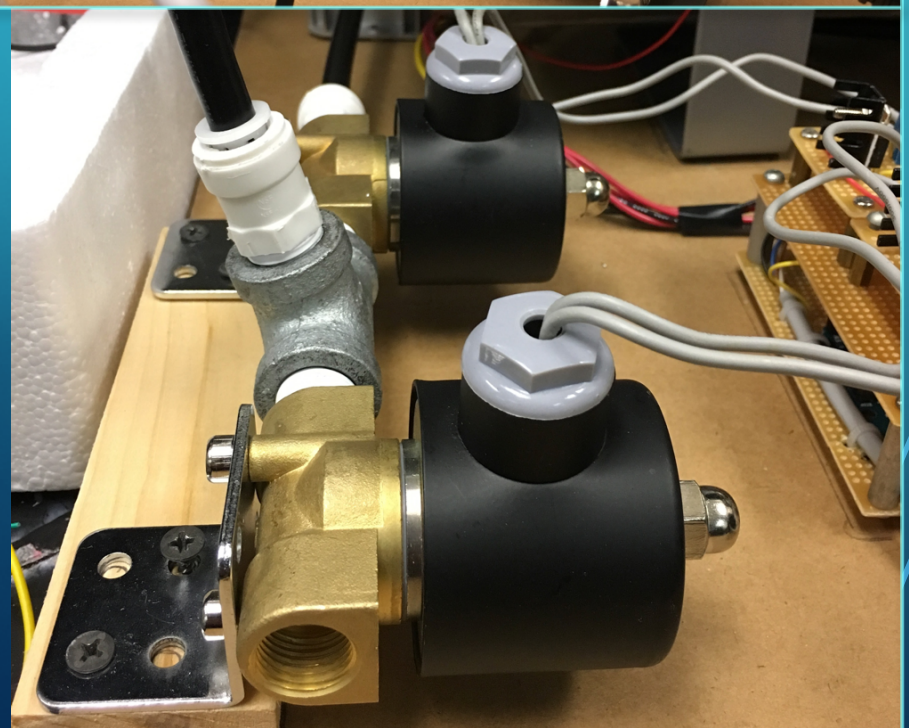
- Will an ultrasonic sensor work in a pressurized environment?
- What circuitry will the Arduino need to communicate with the rangefinder and solenoids?
- If it works, will it be better than current offerings?
  - Fast Response time
  - Durability
  - Easy-of-use

DESIGN AND IMPLEMENTATION

- Size targets
  - the sensor must fit within the physical constrains of the existing air struts.
- Sensing range
  - The sensor must be capable of a range that comfortably exceeds the air bag's range of motion (50mm-300mm)
- Run off the 12 V car battery
- Use Arduino as microcontroller
- Use solenoid valves to regulate air pressure of bag
- Provide a high pressure pneumatic system to inflate the bag when necessary





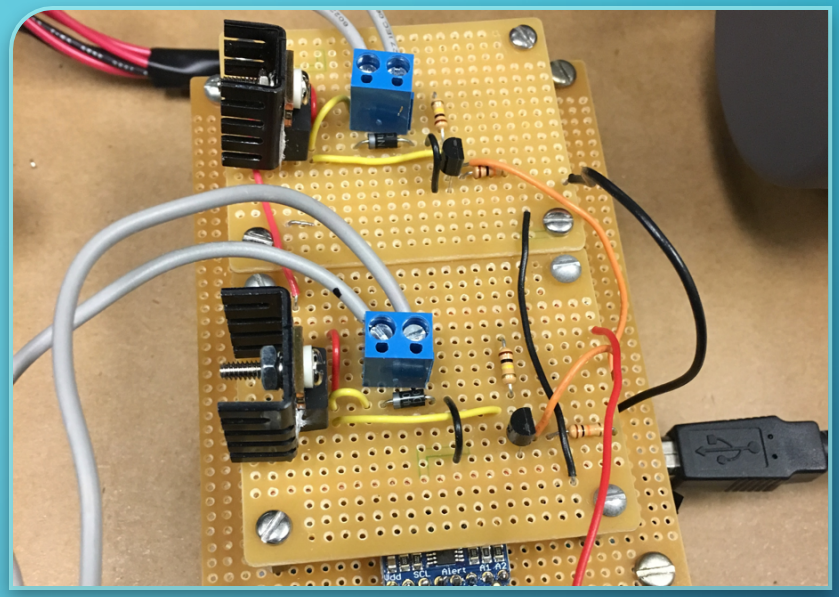


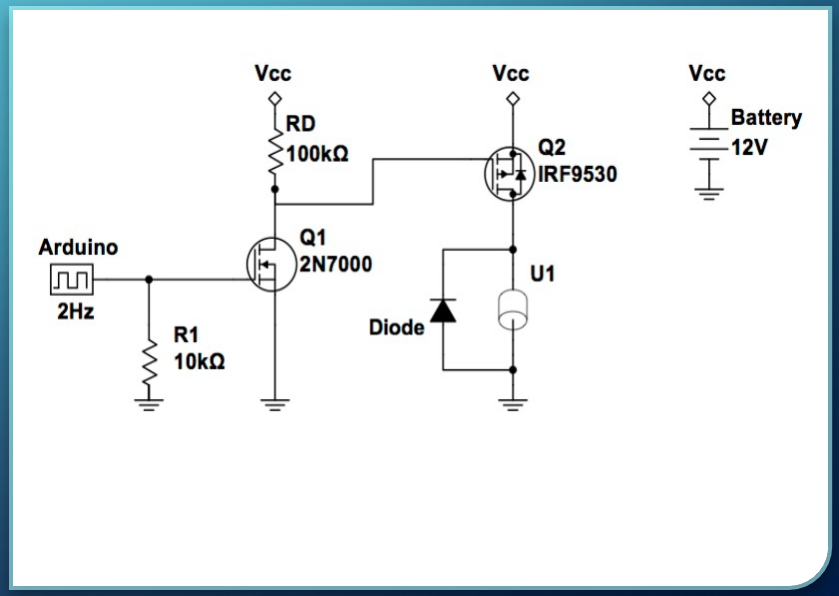
MECHANICAL SYSTEM

- High pressure air reservoir
- Air compressor (VIAIR 380C)
- 3/8” DOT approved air line
- Pressure gauge to monitor tank pressure
- 2x solenoid valves for inflation and deflation of air bag
  - Rated to 200 psi

ELECTRICAL SYSTEM

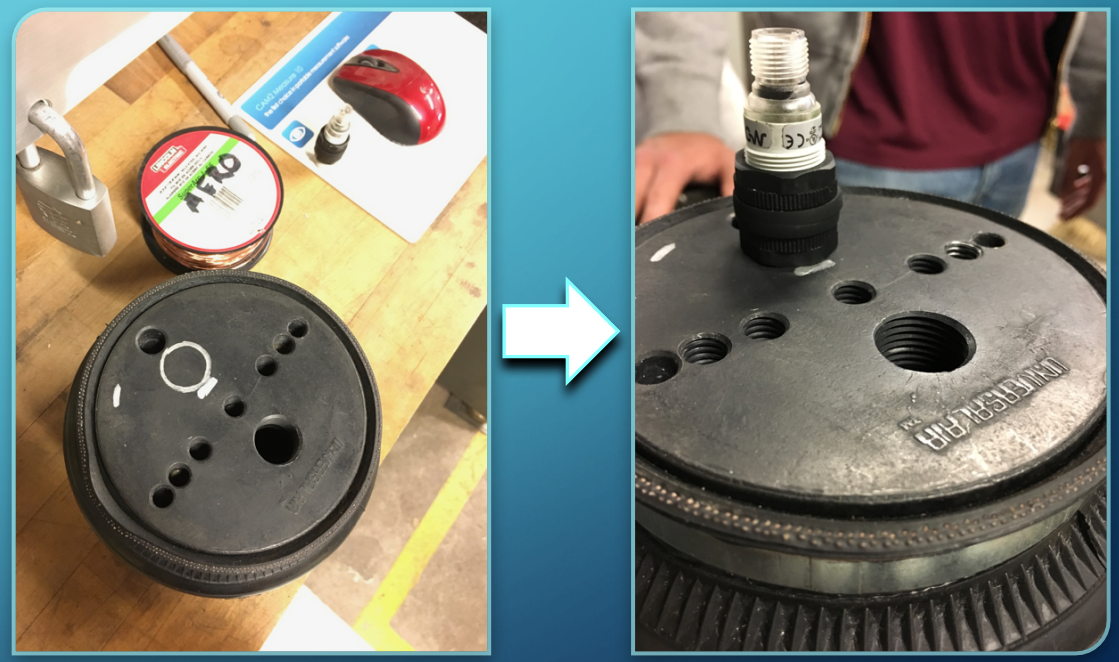
- The signal coming from the Arduino was nowhere near powerful enough to power a solenoid (~8mA).
  - A logic-level shifter for each solenoid was used to convert the 5V Arduino signal into 12W power for each solenoid.



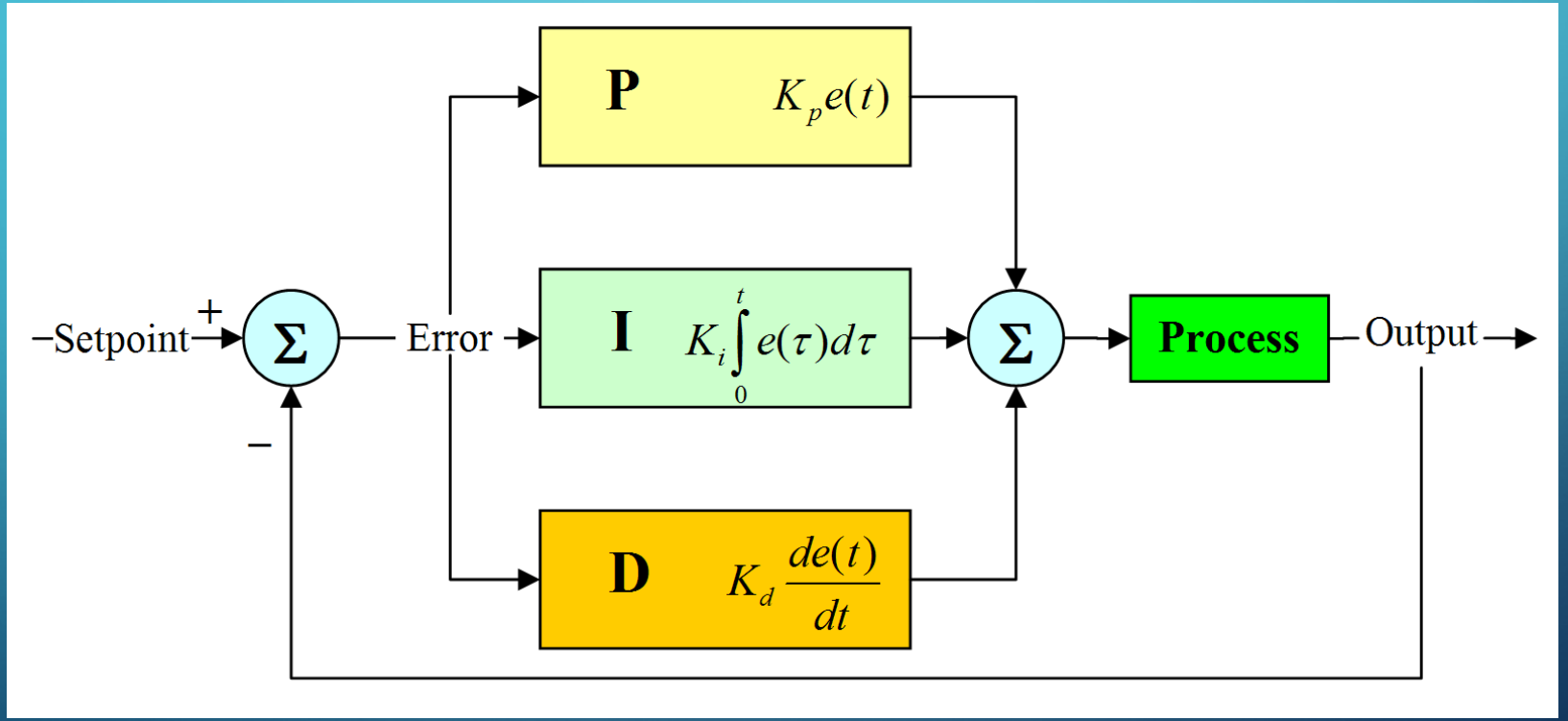


FITMENT OF SENSOR INTO AIR BAG

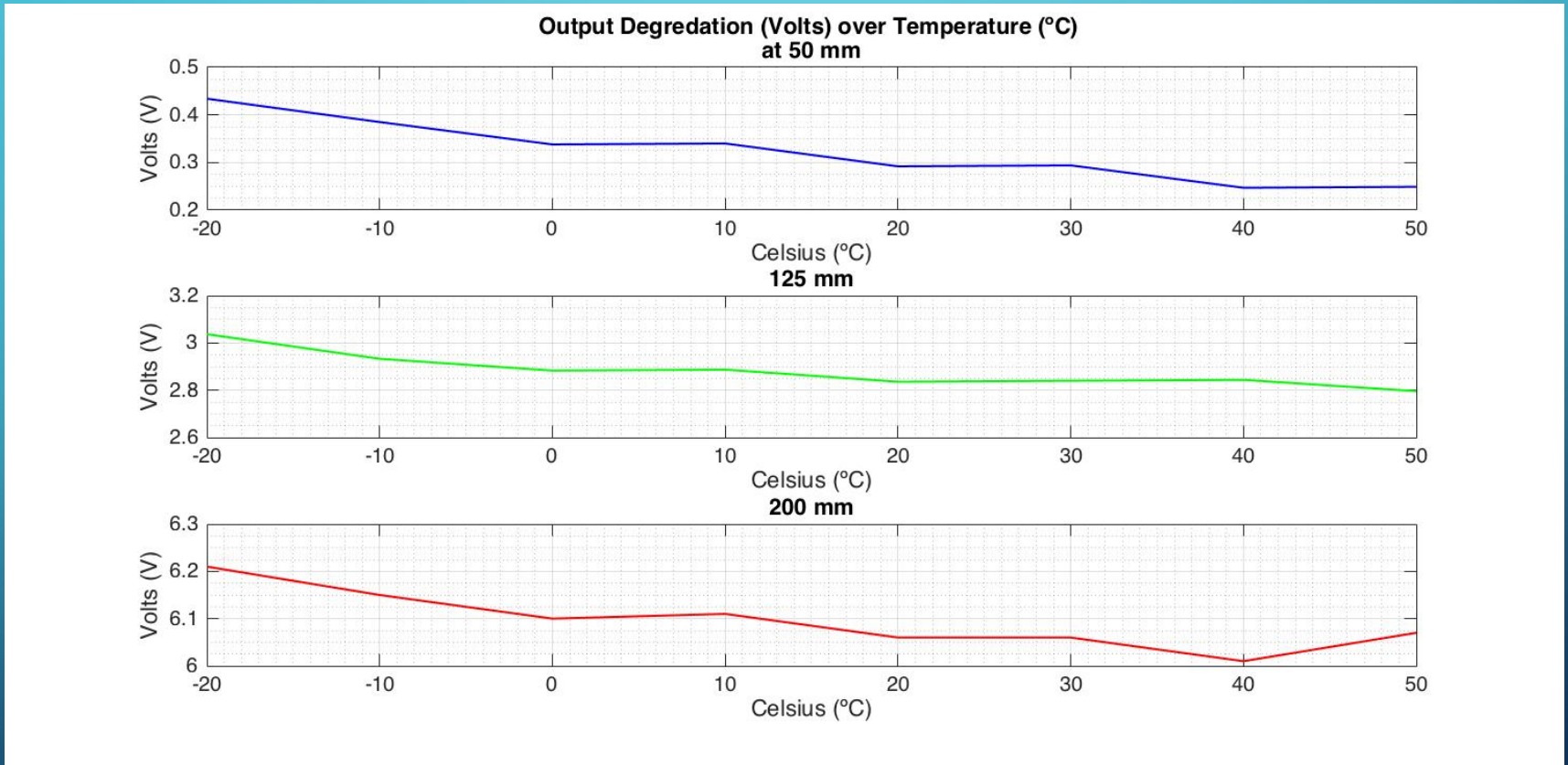
- An outline of the sensor was drawn onto the bag.
- A hole was drilled then threaded to the specification of the ultrasonic sensor.
- Using Teflon™ tape and rubber seals, the sensor was able to keep an air-tight seal.

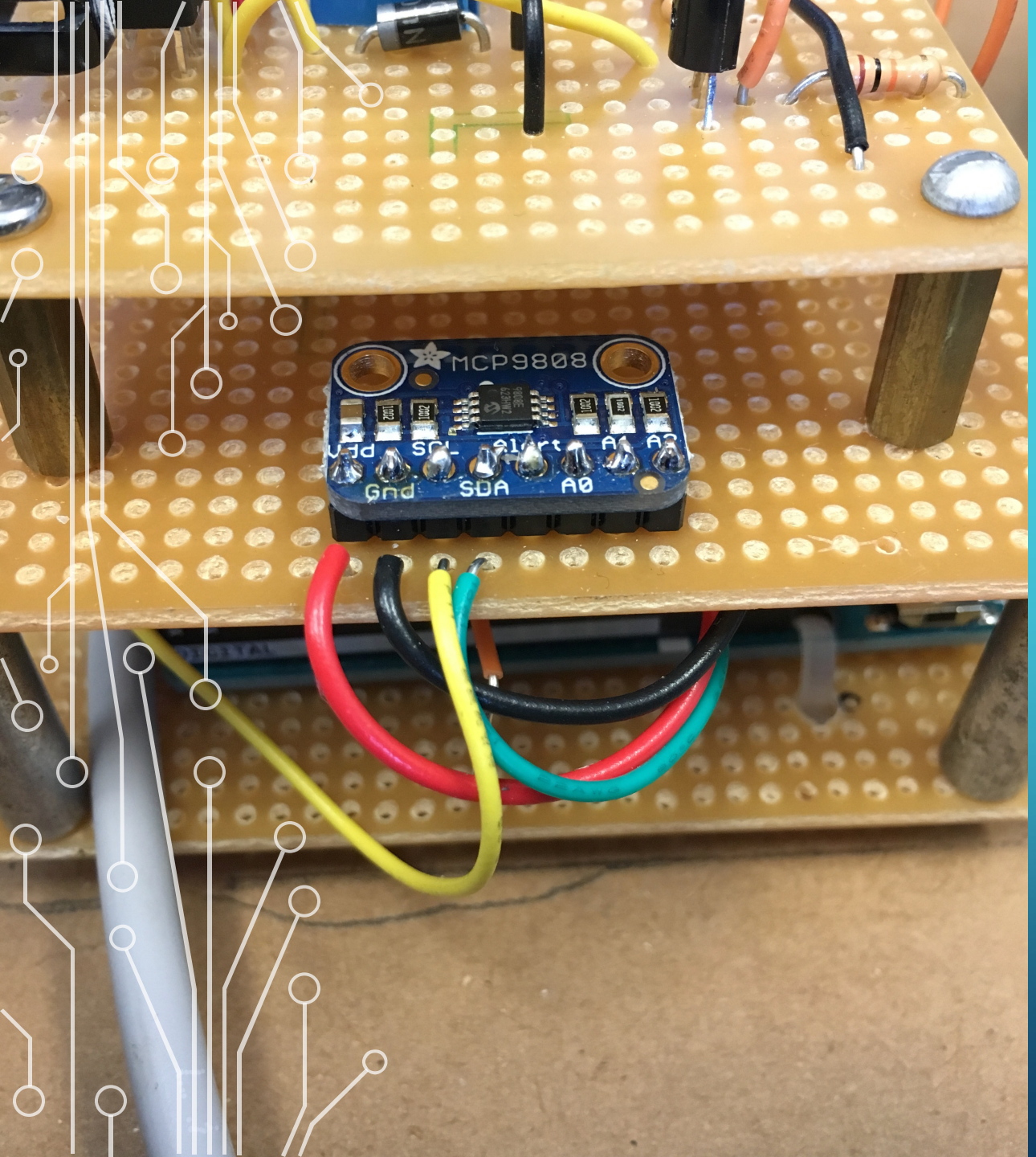


PID CONTROLLER



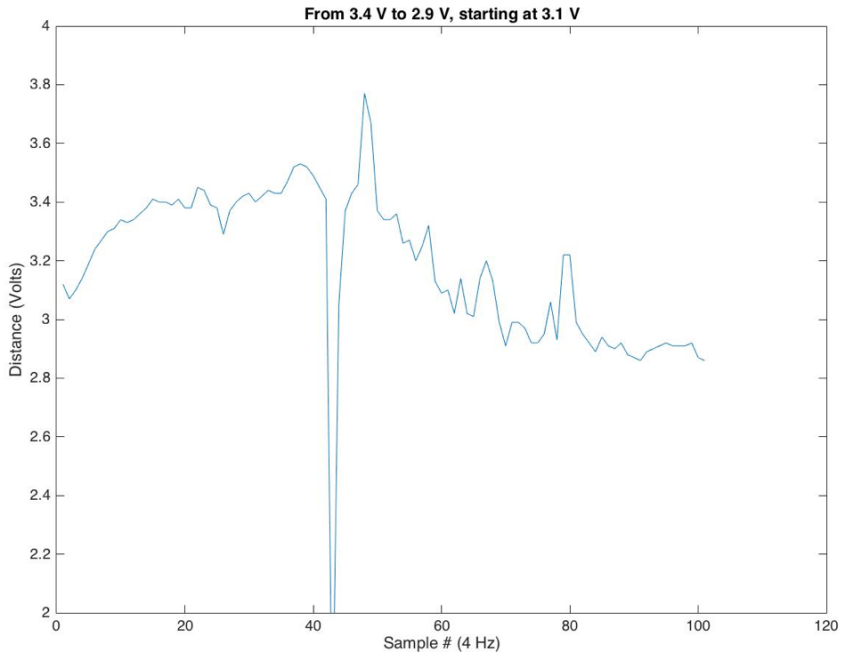
THERMAL PROBLEM

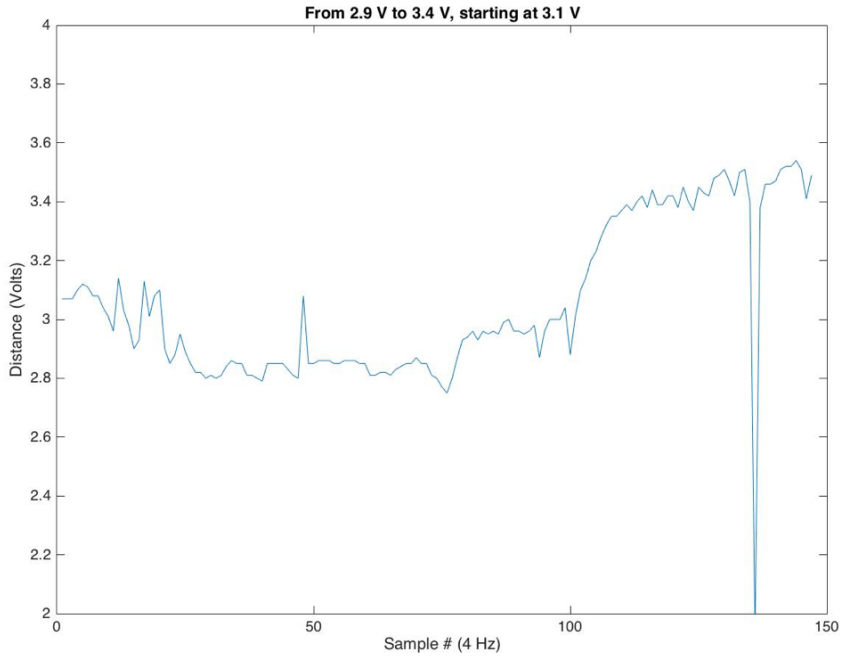




SOLUTION TO THERMAL PROBLEM

- A MCP9808 temperature sensor was used to compensate for the distance sensor's change in output due to temperature changes.
- Implemented into code as a correction matrix





RESULTS

- System response tests were done from 2.9 V to 3.4 V, and from 3.4 V to 2.9.
- Both tests started at an intermediate 3.1 V.
- Large impulse
  - possibly caused by bad data
  - Or by the strong EMF of the solenoids

WHAT I LEARNED FROM CAPSTONE

- Some of the courses that inspired this project
  - ECE363, ECE366, ECE386, ENG100, ECE497
- How Union helped me achieve this project.
- The biggest challenges faced and how they were overcome.

FUTURE WORK

- The relationship between the air pressure within the tank and the flow rate into the air bag is not consistent. To solve this, a pressure sensor would have to measure the tank's pressure and correct the valve timing to fill the bag at a consistent rate.
- The temperature sensor would have to be implemented into the bag to measure internal temperatures since that is the environment that affects the sensor's output the most.
- Finer tuning of flow rates.

QUESTIONS?

ACKNOWLEDGEMENTS

- Walt Dixon, Project Advisor
- Prof. Hedrick, for the tools and lab space
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