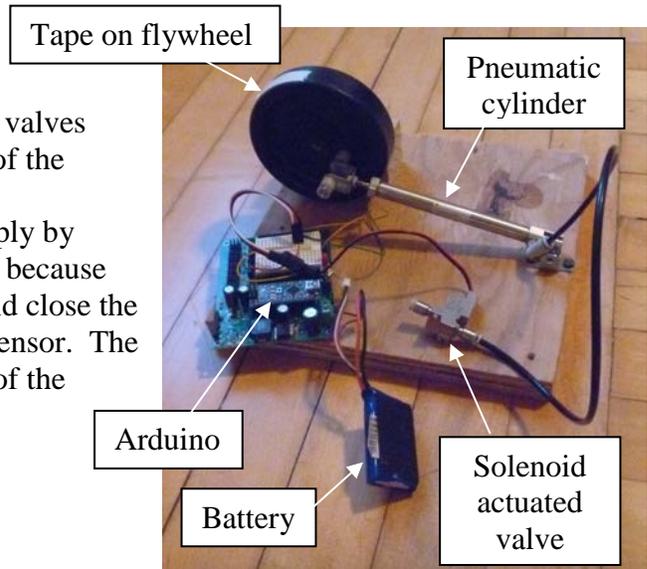


# Optimize an Air Engine with Electronic Valve Timing

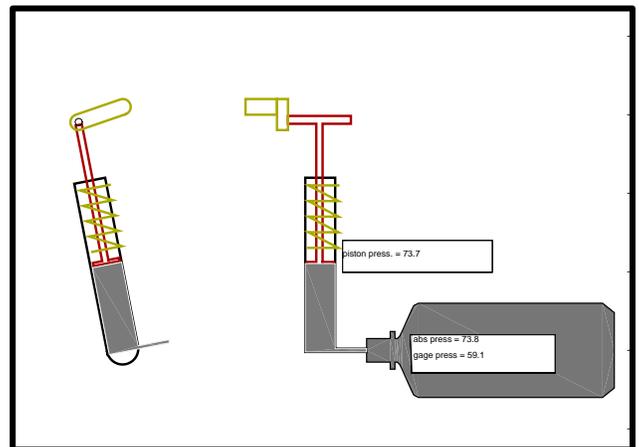
## DESCRIPTION:

This activity is focused on improving the performance of an air engine. This engine is composed of a single pneumatic cylinder attached to a flywheel. This engine type is a “wobbler” in which the cylinder pivots eliminating the need for a connecting rod. When air pressure is applied within the cylinder, the rod extends from within it. When air pressure is relieved within the cylinder, the rod withdraws back into it due to the action of a spring inside it. Solenoid actuated valves control the flow of air in the engine. The timing of the valve(s) opening and closing is essential to good performance. You’ll be able to set the timing simply by applying white tape to the surface of the flywheel because sensors are positioned to detect the white areas and close the valve(s) when the white areas are in front of the sensor. The valve(s) close again when dark areas are in front of the sensor or else when nothing is present.



## EXPERIMENT WITH YOUR AIR ENGINE:

1. Try the initial set up
  - a. Take a supply of pressurized air (such as the two liter bottle) and attach it to the tube that is connected to the solenoid actuated valve
  - b. Turn on the power to the Arduino microcontroller using the silver toggle switch. A greenish yellow LED will light up.
  - c. If the flywheel doesn't start by itself, give it a “kick start” with your fingers
  - d. Observe the performance of the engine. What is its speed? How much torque can it apply? How are torque and speed related?
2. Consider changes to the system
  - a. How could you make the system better? For example, could you adjust the timing of the valves by changing the location or length of the white tape?
  - b. What experiment could validate that the system performance improved?
  - c. Run the MATLAB simulation
  - d. How can the MATLAB simulation be used to make your optimization process more effective?



Example output from a MATLAB model of the air engine “air\_engine\_v5.m”