



N F P A

Fluid Power

= **VEHICLE**

Challenge



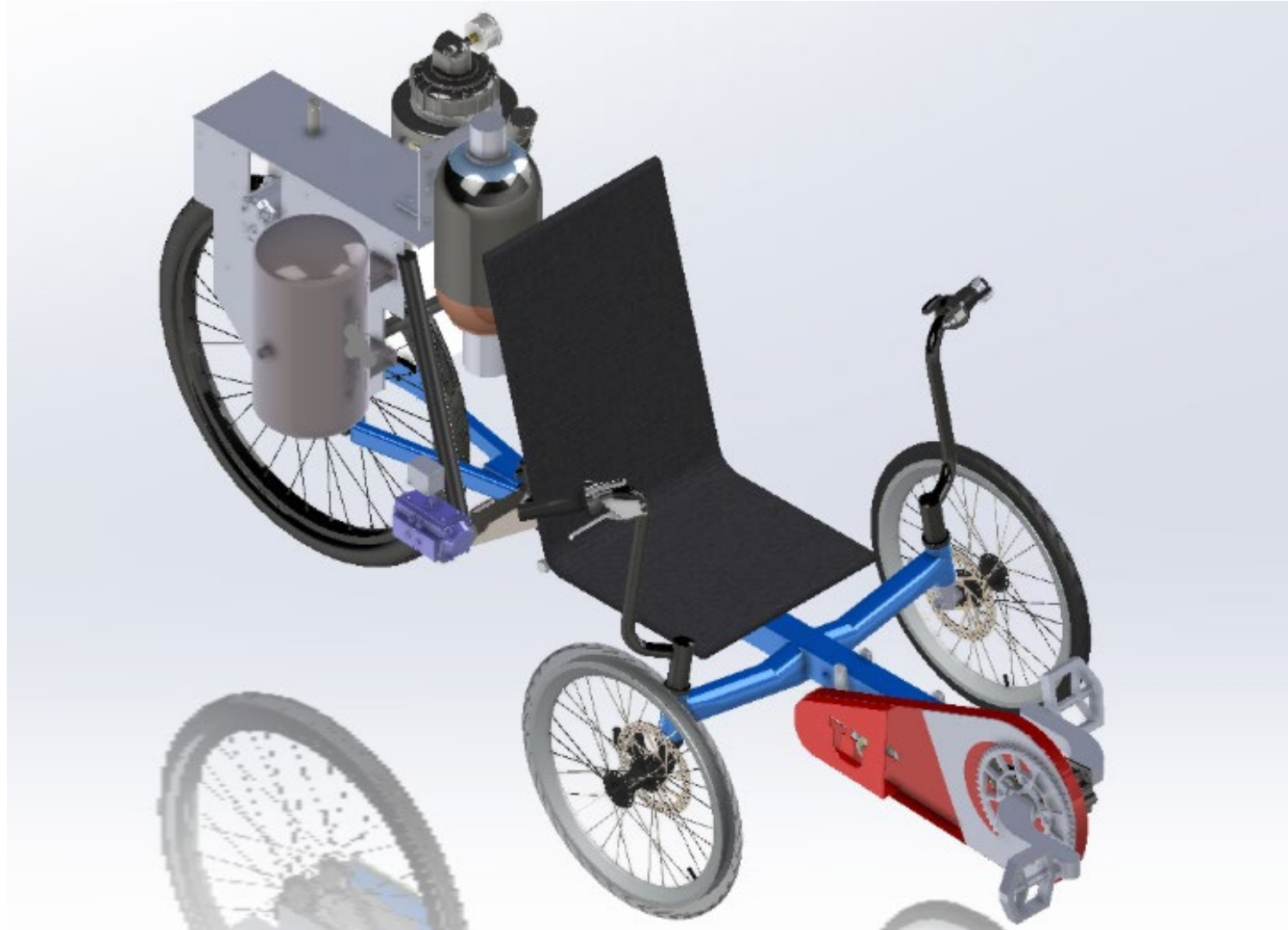
NFPA
Education and
Technology
Foundation

FINAL PRESENTATION &
DESIGN REVIEW
University of Utah
M. Dillon
4/9/2026



THE
UNIVERSITY
OF UTAH

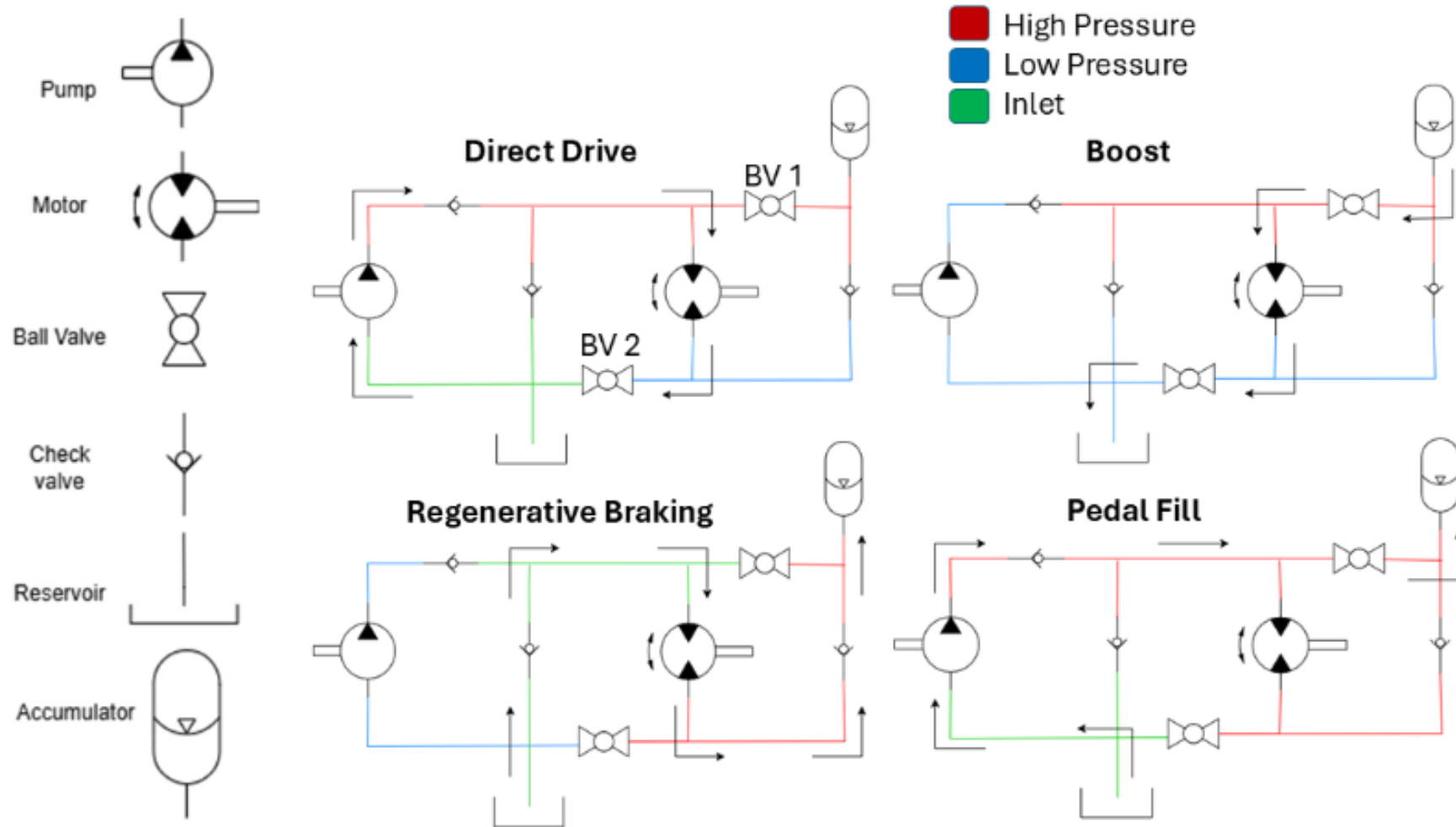
Final Vehicle Design



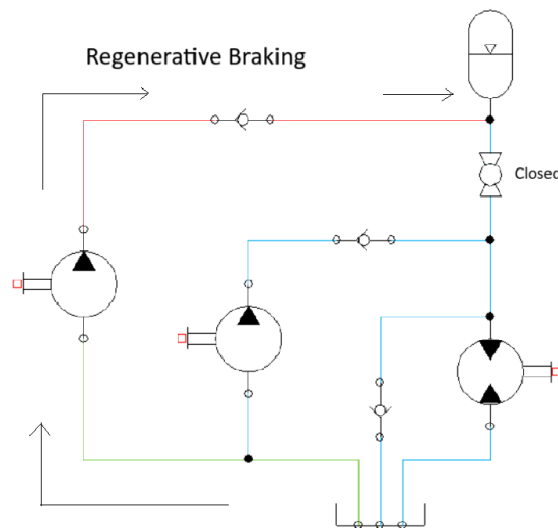
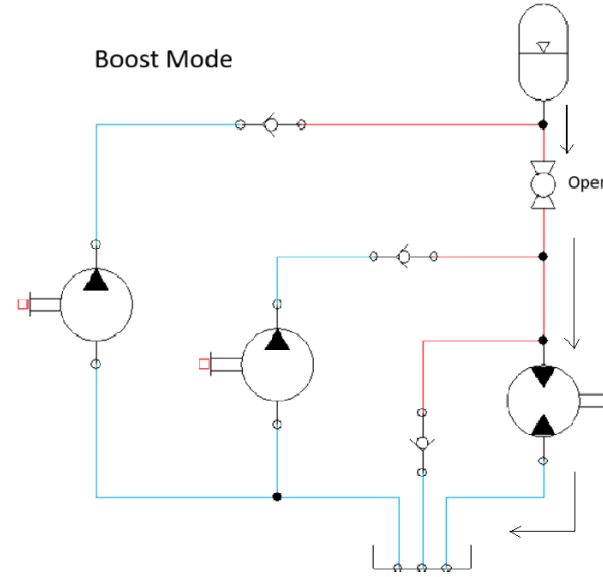
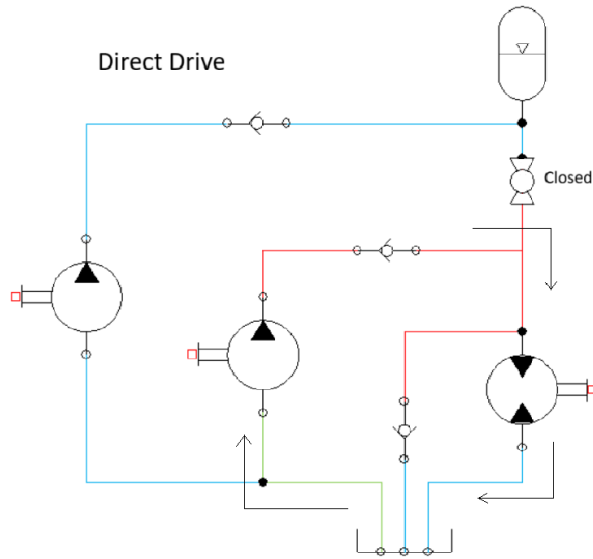
Final Vehicle Design



Previous Hydraulic Circuit

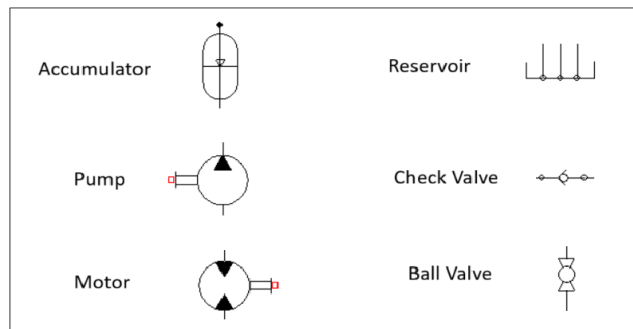


Current Hydraulic Circuit

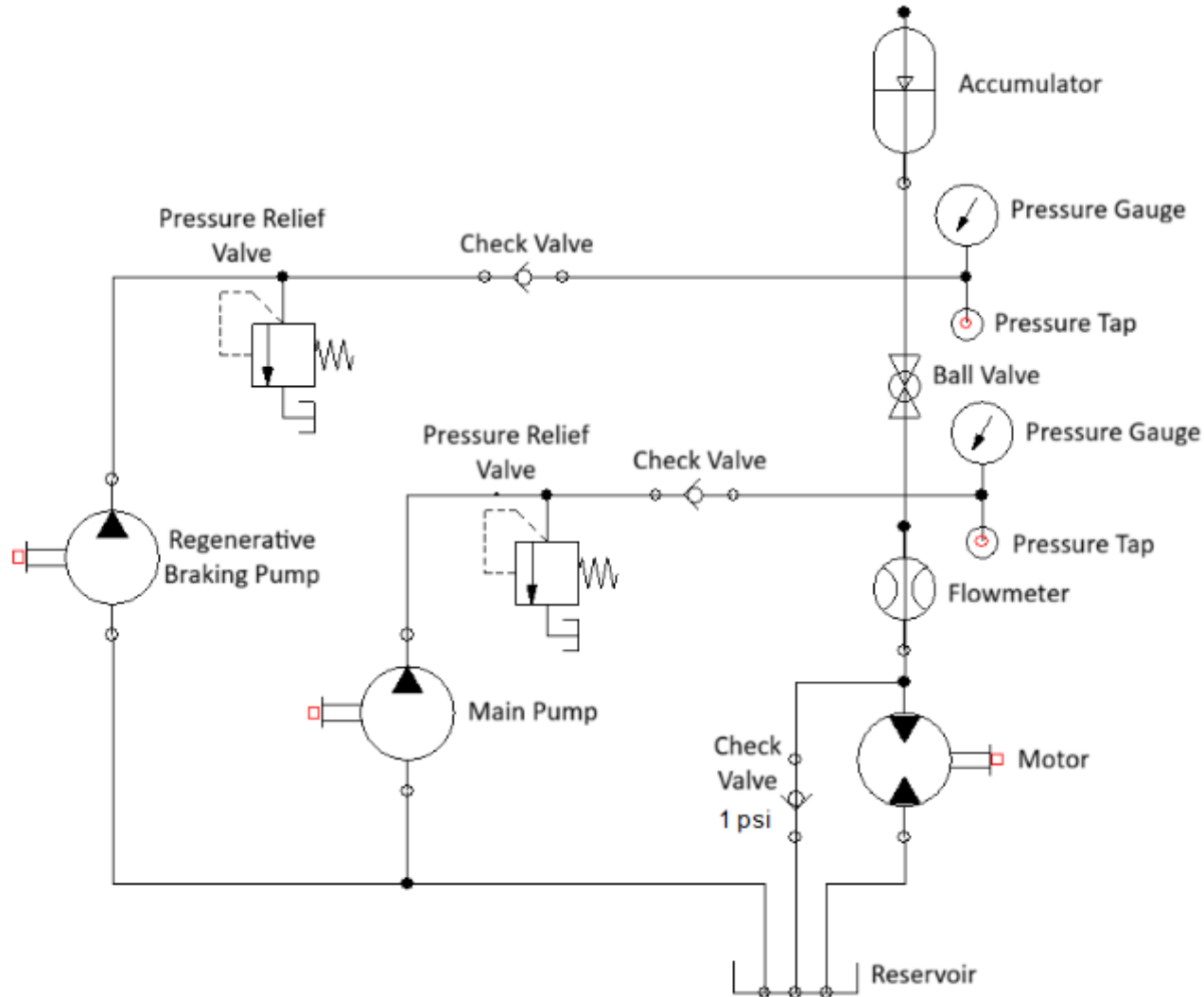


Legend

- High Pressure
- Low Pressure
- Inlet



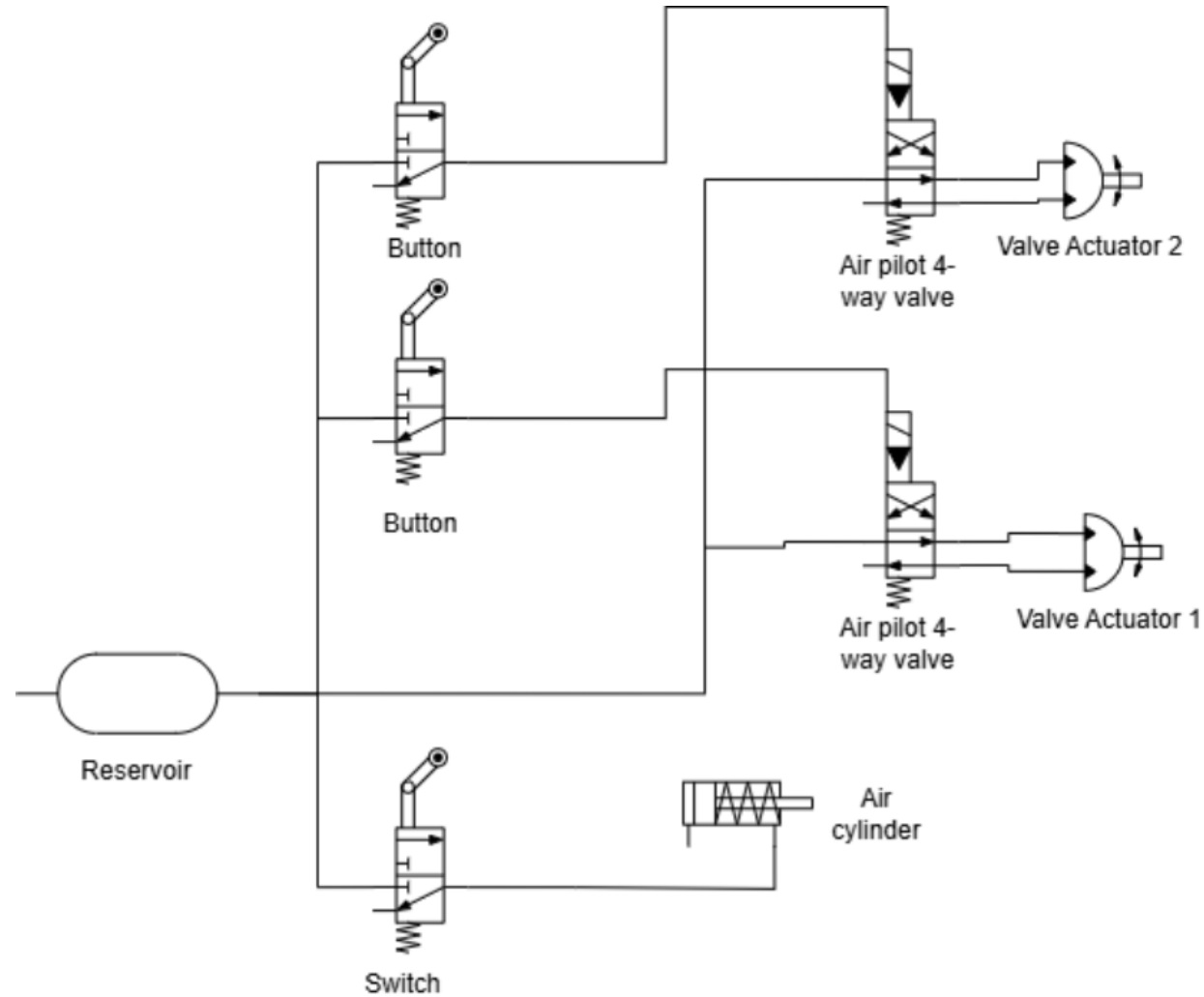
Current Hydraulic Circuit



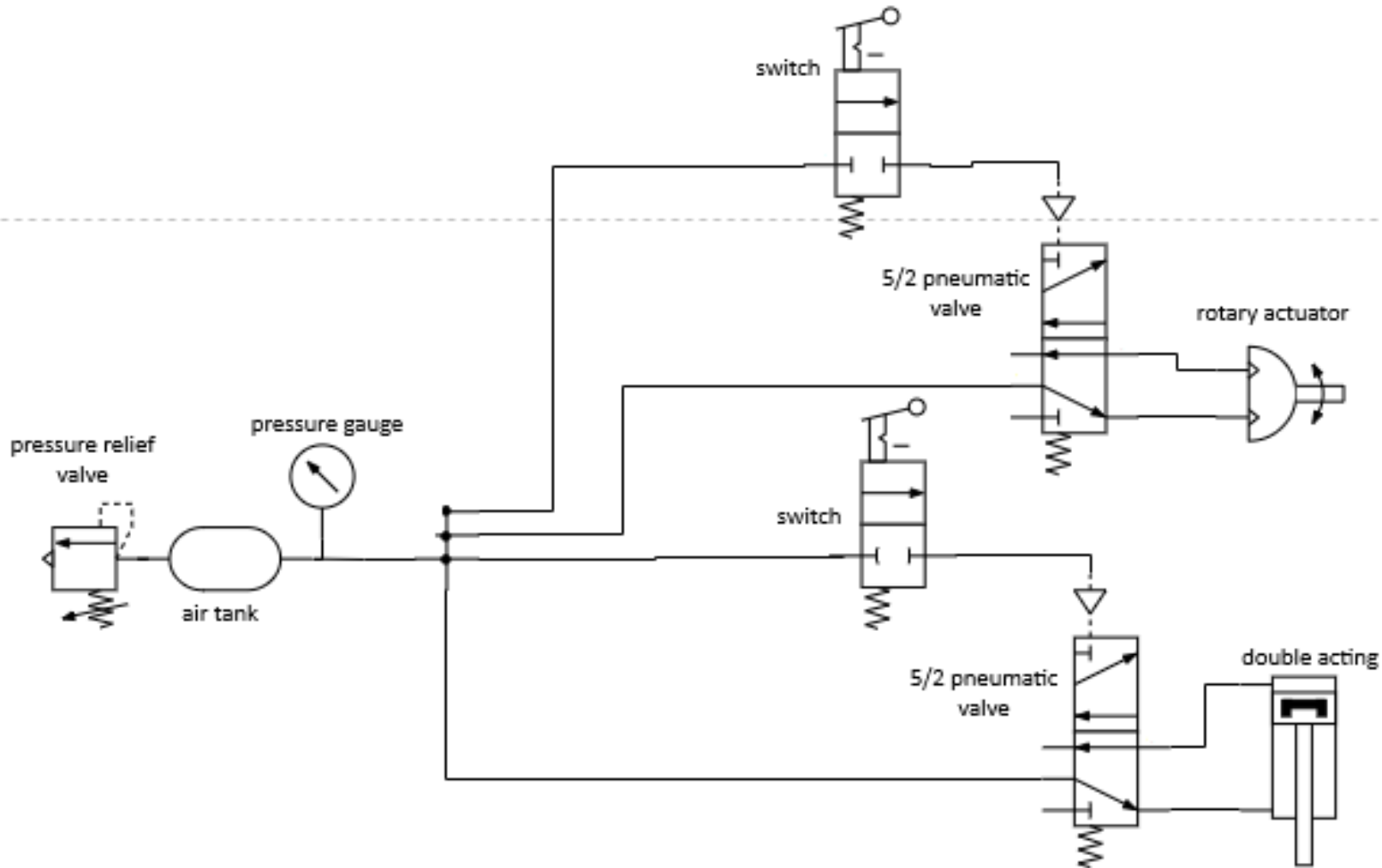
Changes:

- Added second pump for regenerative braking
- Separated regenerative braking circuit
- Removed one ball valve
- Added flowmeter
- Removed "Pedal Fill" mode
- Replaced hoses and accumulator
- Electronic pressure gauges instead of physical

Previous Pneumatic Circuit



Current Pneumatic Circuit



Changes:

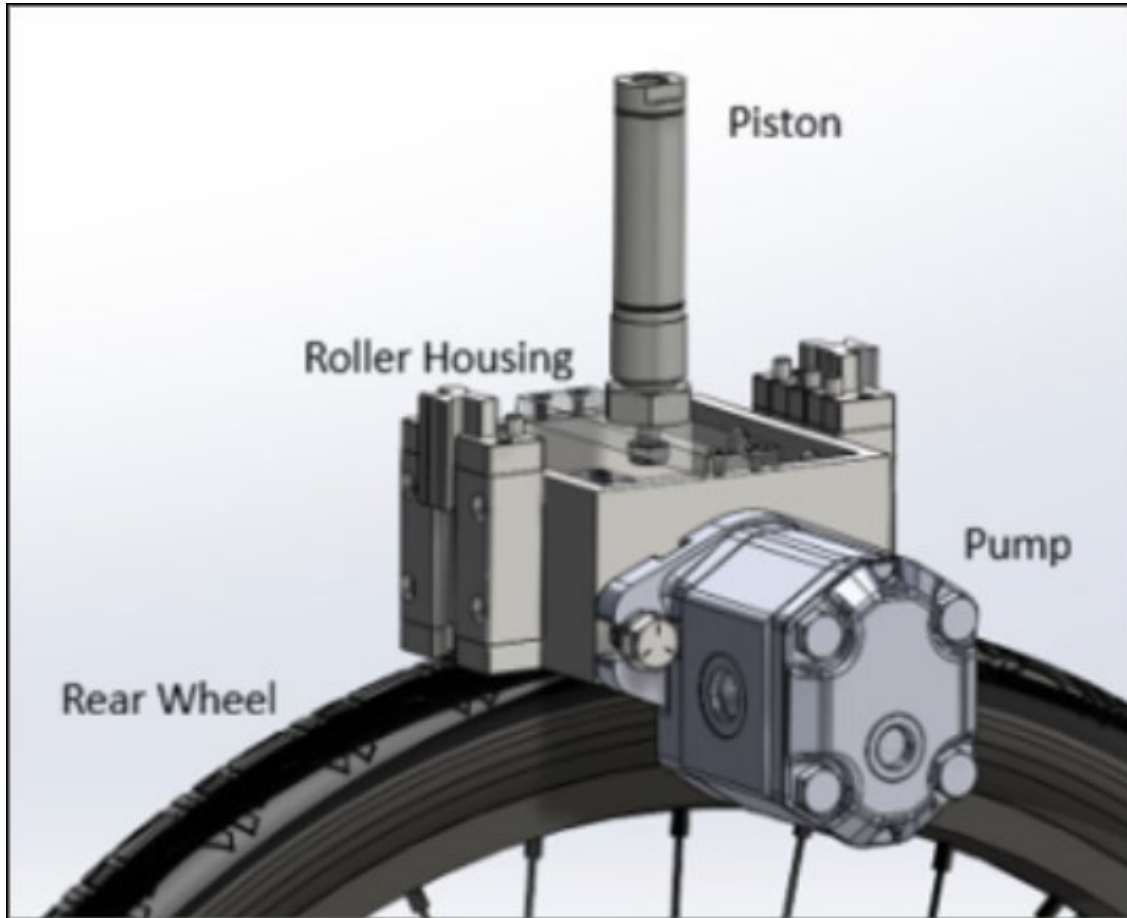
- Removed one ball valve
- Added a piston for regenerative braking
- Removed pressure regulator
- Permanently locked clutch
- Replaced all hosing, fittings
- Added switches for ease of use



Design Decisions

- Added separate regenerative braking circuit
- Redesigned hydraulic and pneumatic circuits
- Removed one ball valve
- Added electronic monitoring
- Replaced steel reservoir for a lighter plastic one with integrated filter
- Mounted accumulator vertically and centralized on vehicle
- Permanently locked clutch

Regenerative Braking



- Piston moves subsystem vertically up and down
- Roller is attached to pump shaft
- Roller rests on rear tire and spins with it
- Pump forces fluid into accumulator



Vehicle Testing + Adjustments



Regenerative Braking Testing:

After getting two very low distances and speeds in a row, the vehicle was inspected and found that the regenerative braking roller shook loose. It was tightened back on and values improved.

	Stopping distance	Boost distance	Boost Speed
Run 1	50 ft	19 ft	3.1 mph
Run 2	52 ft	8 ft	2 mph
Run 3	50 ft	3 ft	0.9 mph
Run 4	48 ft	22 ft	3.4 mph
Run 5	65 ft	43 ft	4 mph

Direct Drive Testing:

	Average Speed
Run 1	7 mph
Run 2	8.5 mph
Run 3	8 mph
Run 4	6.75 mph

Boost Testing:

	Pressure	Distance	Max Speed
Run 1	2550 psi	310 ft	13 mph
Run 2	2500 psi	1050 ft	23.9 mph
Run 3	2900 psi	300 ft	14 mph
Run 4	2080 psi	310 ft	13.7 mph



Lessons Learned

- Maintain structure within scheduling
 - Budget for time delays
- Utilize resources from technical advisors
 - Problem analysis from experts
- Divide and conquer method
 - Implement quality control steps to ensure all components are completed accurately and in a timely manner