Parker Hannifin's Chainless Challenge 2012

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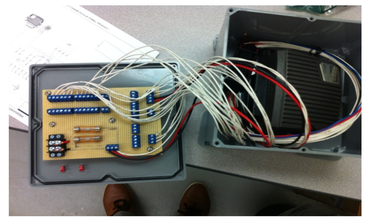
Agricultural & Biological ENGINEERING

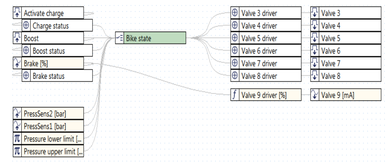
April 19, 2012

Concept:

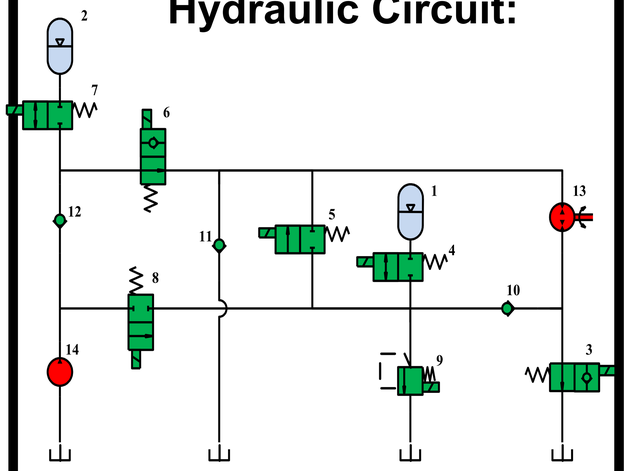
The purpose of this project was to create a hydraulic or pneumatic driven bicycle that is powered by human input. The team decided to chose a hydraulic drive vehicle due to the fact that there can be more force delivered with hydraulic oil than air. The basic concept of the vehicle was a two wheeled bicycle powered by a hydrostatic transmission. A gearbox is turned using the riders legs/feet, this powers a pump that drives fluid to a motor. The motor is connected to an internal gear hub on the rear wheel. There are four modes of the hydraulic circuit; Pedaling, Braking, Charging, and Accumulator. These are all directed by cartridge valves put into a valve block. Parker Hannifin's IQAN software was used to program the controller.

IQAN:

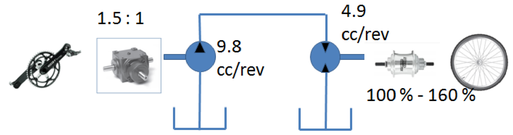




Hydraulic Circuit:



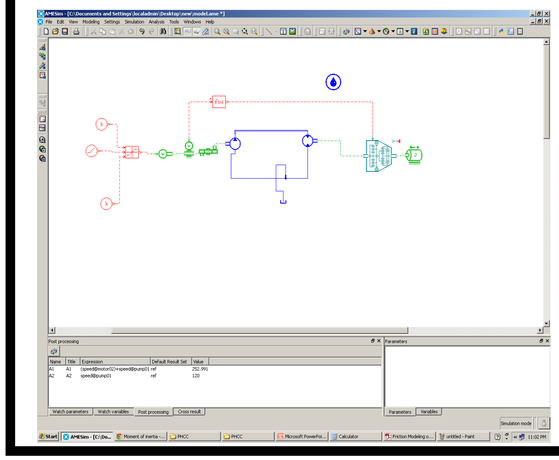
Sizing:



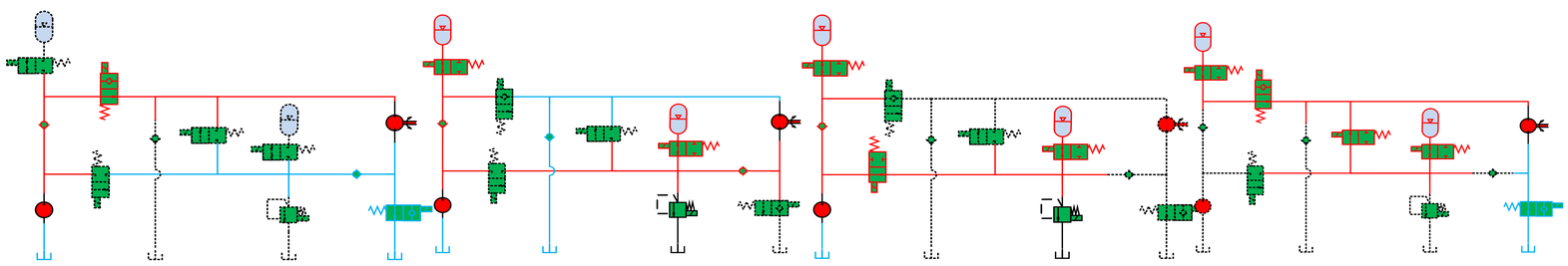
$$\eta_{motor} = \frac{T_{eff} \cdot \omega}{Q_{eff} \Delta P} = \eta_{vol} \eta_{hm}$$

$$\eta_{pump} = \frac{Q_{th} \Delta P}{T_{eff} \cdot \omega} = \eta_{vol} \eta_{hm}$$

Simulation:



Operating Modes:



Mode	Pedal	Charge	Boost	Brake
Valve 3	On	-	On	-
Valve 4	-	On	On	On
Valve 5	-	-	On	-
Valve 6	On	-	On	-
Valve 7	-	On	On	On
Valve 8	-	On	-	-
Valve 9	-	-	-	Active

Parts/Cost:

COMPONENT	DESCRIPTION	PRICING ($)
Pump/motor	Axial piston	615
Pump	Axial piston	700
Accumulator 1	B Series Piston Accumulator	400
Accumulator 2	B Series Piston Accumulator	309
6 Directional Valves	Bi-Directional Electrohydraulic valves Poppet Type, 2-Way	500 (estimated)
Proportional relief Valve	Poppet Type, 2-Way Valve	400 (estimated)
2 Check Valves	Valve, Hydraulic Check	100 (estimated)
Hydraulic Fluid	Mobile Hydraulic Fluid – 5gal	200 (estimated)
Electronic components	for control box assembly	120
Hoses and Fitting		350
Bicycle Frame		200
Additional bicycle parts	Seat, rear wheel , sprockets etc. Internal gear hub, speed reducer, and oil	865
Batteries and charger		190
Control Unit	IQAN-MC2	
Tools	Bicycle tools	20
Materials cost	Frame materials	300
Labor Cost		7200
	TOTAL	**12,469**

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